



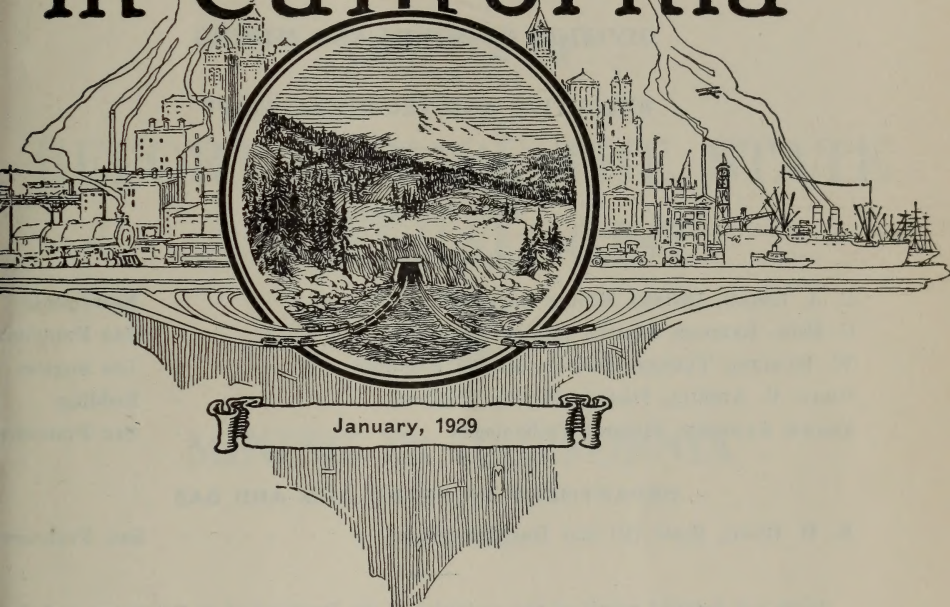








# Mining in California



January, 1929

PUBLISHED QUARTERLY

STATE OF CALIFORNIA  
DIVISION OF MINES AND MINING

FERRY BUILDING  
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WALTER W. BRADLEY

*State Mineralogist*

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#### DEPARTMENT OF PETROLEUM AND GAS

R. D. BUSH, State Oil and Gas Supervisor	-	-	-	-	-	San Francisco
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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the Division of Mines and Mining, entitled 'Summary of Operations, California Oil Fields.'



STATE OF CALIFORNIA  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF MINES AND MINING  
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY

State Mineralogist

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CHAPTER OF  
REPORT XXV OF THE STATE  
MINERALOGIST

COVERING  
MINING IN CALIFORNIA

AND THE  
ACTIVITIES OF THE DIVISION OF MINES  
AND MINING





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## PREFACE

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The Division of Mines and Mining (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines and Mining.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines and Mining is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

State of California  
DIVISION OF MINES AND MINING  
WALTER W. BRADLEY

STATE MINERALOGIST

OUTLINE MAP  
OF  
CALIFORNIA

SCALE



•LEGEND•

- Mining Division Boundaries.
- Mining Division Offices.

MEXICO

## DISTRICT REPORTS OF MINING ENGINEERS

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In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

### New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It was deemed advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

### SACRAMENTO FIELD DIVISION

C. A. LOGAN, Mining Engineer

On account of unfinished field work, there is no report from the Sacramento Field Division in this issue.



## REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

## LASSEN COUNTY

**Geography.**

Lassen County is located in the northeastern part of the state just south of Modoc County, which lies in the northeastern corner. The eastern boundary line forms part of the line between Nevada and California. Honey Lake Valley, an important part of Lassen County, was thought by the early settlers to be in the state of Nevada, and was put into one of the judicial districts of that state. The resulting dispute was settled by a survey of the state line, and Lassen County was set off in 1864. The area of the county is 4600 square miles. The two principal towns are Susanville, the county seat, and Westwood, which is owned entirely by the Red River Lumber Company. The population of each of these is about 5000 persons.

**Topography.**

High forest-covered mountains, plateaus also covered with forest and valley lands occupy about equal portions of the total area of the county. Honey Lake Valley, Big Valley and Long Valley are at elevations of about 4000 feet; the other important valley, Madeline Plains is a little more than 1000 feet higher. The plateaus are at elevations of about 6000 feet, and the mountains reach 7000 and 8000 feet. The southern portion of the county drains into Honey Lake through Susan River, Long Valley Creek and smaller streams; the northern portion drains into Pit River. Honey Lake is a large body of water in the southeastern part of the county, covering 64,000 acres when filled, but it evaporates rapidly during the summer months; and in the summer and fall of 1928, it was dry. Eagle Lake, in the central portion of the county, with an area of 27,813 acres, is 1000 feet higher in elevation than Honey Lake, and is much deeper. A portion of Lassen Volcanic National Park is in Lassen County, but Lassen Peak, the only volcano in the United States that has been active in recent years, is in the part of the Park located in Shasta County.

**Climate.**

Moderate temperature prevails for the greater part of the year; the days are warm and the nights are cool, and very little rain falls. From the middle of December to the middle of March, the weather is cold and snowstorms are frequent. Precipitation amounts to 11 inches of water annually at Litchfield in the eastern part of Honey Lake Valley, and 20 inches at Susanville. In the mountains, it is greater, and falls largely as winter snow.

**Industries.**

Lumbering, stock-raising and farming are the chief industries. The largest lumbering operation is that of the Red River Lumber Company at Westwood. The mill supports a community of 5000 people, and an additional 3000 are employed in the lumber camps during the spring, summer and fall. Other mills are operated by the Lassen Lumber and Box Company and the Fruit Growers Supply Company at Susanville. Privately owned timber-land amounts to 300,000 acres,



nd National Forest to 277,000 acres in the county. Lumbering is said to be on a permanent basis here, with 100 years supply available and a growth-cycle of 60 years. The annual production is 350,000,000 board feet, or about one-quarter of that for the state. In addition to lumber, ply-board and veneer-board are made. The Red River Lumber Company develops 20,000 h.p. of electric power from steam and hydro-electric plants; and sells the power at Susanville and other places in the county.

Large numbers of sheep and cattle feed on the ranges of Lassen County. Some 100,000 acres of land are under irrigation with water from Pit River, Susan River and Eagle Lake. The largest crops are those of hay and alfalfa, but grains are important, and vegetables, berries and deciduous fruits are raised. With the exception of beef and mutton, there is a local market for all of the farm products of the county, because of the large number of persons employed by the lumber mills.

#### Transportation.

The county is served by three railroads. The Western Pacific crosses the southeastern corner, the Nevada, California and Oregon, which has just been made broad gauge by the Southern Pacific, crosses the county from north to south, and the Southern Pacific runs practically across the southern portion in an easterly and westerly direction. The state highway from Red Bluff to Reno, Nevada, crosses the southern portion of the county, and passes through Susanville. Another state highway from Redding to Alturas crosses the northwestern corner. Other roads make practically all points in the county accessible.

#### Geology and Mineral Deposits.

Tertiary rocks cover all of Lassen County except a strip along the southern border. Undoubtedly, these formations are less favorable to the occurrence of valuable and deep-seated mineral deposits than the older formations of the Sierra Nevada; and perhaps, on this account, prospecting has been neglected. The writer has not examined the Tertiary formations of Lassen County in any detail, but an examination of the Warner Mountains to the north in Modoc County shows a great similarity in formations to those of the Tonopah and Goldfield districts in Nevada, which have been very productive. Present prospecting is confined to the narrow band of older rocks exposed along the southern border. The geological map of the state published by this bureau in 1916 indicates that this band of plutonic rocks is a part of the large body with which the ores of the Engel mine and the Walker Mine in Plumas County are associated. One prospect in which small amounts of copper ore have been found, and several gold prospects are now active. The Hayden Hill district, which has been described in some detail by Tucker<sup>1</sup> and by Hill,<sup>2</sup> has not been active in recent years. A few notes on this district will be found in descriptions that follow.

The total recorded mineral production of the county is shown by the accompanying tabulation.

<sup>1</sup> Tucker, W. B., Report XV of the State Mineralogist, 1915-1916.

<sup>2</sup> Hill, J. M., U. S. Geol. Survey, Bull. 594.

## LASSEN COUNTY, 1880-1927.

Year	Gold, value	Silver, value	Miscel- laneous stone, value	Miscellaneous and unapportioned		
				Amount	Value	Substance
1880.....	\$25,900					
1881.....	71,000	\$1,000				
1882.....	100,000	20,000				
1883.....	20,000	5,000				
1884.....	119,060	341				
1885.....	15,000	150				
1886.....	25,812	135				
1887.....	24,108	304				
1888.....	50,000	200				
1889.....	97,503	215				
1890.....	14,890	300				
1891.....	3,676					
1892.....	15,400					
1893.....						
1894.....	35,283					
1895.....	25,000					
1896.....	40,300					
1897.....	49,100	850				
1898.....	37,460	300				
1899.....	28,898					
1900.....	19,807	676				
1901.....	5,900	200				
1902.....	23,410	244				
1903.....	91,102	1,203				
1904.....	116,993	1,515				
1905.....						
1906.....	2	2				
1907.....	2	2				
1908.....	7,284	783				
1909.....	116,327	1,463			\$217,521	Unapportioned, 1900-19
1910.....	82,180	972				
1911.....					1,522	Gold and silver.
1912.....						
1913.....		2	\$2,030			
1914.....	1,250	4	775			
1915.....			870			
1916.....			9,725			
1917.....			376			
1918.....			800			
1919.....			1,100			
1920.....			7,313		5,000	Other minerals.
1921.....	39,943	1,234	42,308			
1922.....	2	2	9,540		17,877	Brick, gold and silver.
1923.....	2		7,600		240	Gold and silver.
1924.....	2,250	44	35,614			
1925.....	1,130	24	1,250			
1926.....	67	1	18,995			
1927.....	531	9	47,885		1,000	Granite curbing.
Totals.....	\$1,307,564	\$37,169	\$186,181		\$243,160	

<sup>1</sup>Lawver, A. M., in 'Production of Precious Metals in U. S.': Report of Director of Mint, 1884, p. 175, 1885.

<sup>2</sup>See under 'Unapportioned.'

<sup>3</sup>Includes Modoc and Colusa Counties' production.

<sup>4</sup>Includes Colusa county production.

<sup>\*</sup>Copper production erroneously reported from Lassen County in the years 1913 and 1914, on account of shipping point being Doyle, while producing copper mines were located in Plumas County.

## COPPER

The Engels copper mine is only a few miles south of Lassen County and the formations with which it is associated extend northerly across the county line. This has led to some prospecting in the vicinity, but activity at the present time is all on the Plumas County side of the line, so far as the writer knows. Activity in this district has been described in former reports by Tucker <sup>3</sup> and Laizure.<sup>4</sup>

<sup>3</sup> *op cit.*

<sup>4</sup>Laizure, C. McK., Report XVII of the State Mineralogist, 1920, p. 507. For Plumas County, see 'Mining in California,' published by State Division of Mines and Mining, October, 1928.

*Corona Mining Company.* A. C. Marr has recently been president, then W. B. Vanderlip, and now (December, 1928) E. G. Scammon. Westwood is president. Edward Fex is secretary. The property composed of 700 acres of locations in the northwest part of T. 26 N., R. 15 E. The camp is one mile south of the state highway from Susanville to Reno, at a point 13 miles north of Doyle, a station on both the Western Pacific and the Nevada, California and Oregon Railroad. At the time of visit, equipment consisted of cook-house and cabins to accommodate about a dozen men, and a blacksmith shop and tools. According to reports, a compressor has since been added. A shaft, said to be 50 feet deep, was filled with water to a point about 15 feet below the surface. At this level the top of a tunnel was observed. This had been driven under a cropping of diorite that showed a small amount of disseminated chalcopyrite. A tunnel, 50 feet long, in the canyon below this shaft showed nothing but



Cabin at Badger Group.

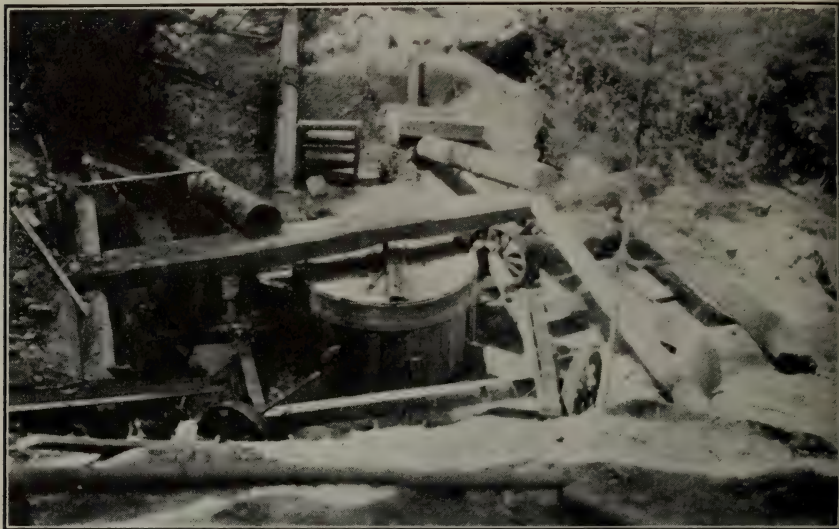
country rock. Neither of these had been worked recently. At a point in a canyon about a quarter of a mile above the camp, a tunnel had recently been driven ahead about five feet to reach a total length of 77 feet. The face showed disseminated chalcopyrite in the country rock. A steep and narrow road had recently been built from the camp to the portal of this tunnel and the blacksmith shop had been moved to its portal. Some surface trenching had recently been done. The property was idle at the time of visit, but reports indicate that the 77-foot tunnel is now being driven ahead to reach a point under some gossan exposed on the surface above.

#### GOLD

*Badger Group.* Owner, H. Sundberg of Milford. Location, Sec. 32, T. 27 N., R. 15 E. The nearest railroad is at Doyle, 14 miles southeast. The road is good to within 2 miles of the mine. The last  $1\frac{1}{2}$  miles



to the camp is steep wagon road, and  $\frac{1}{2}$  mile from the camp to the workings is trail. One hundred eighty acres are held by location. The elevation is 6000 feet, and there is a good stand of timber on the property. It was discovered in 1900, but was worked little until 1927. A fissure vein five feet wide in granite strikes S.  $32^{\circ}$  W. and dips  $70^{\circ}$  E. The filling of the vein is quartz, and it apparently follows an aplite dike. The quartz shows some pyrite and copper-stain. The vein is opened



Arrastra on Blue Bell Group.  
(Operation was not satisfactory.)

by means of two tunnels. The upper is 80 ft. below the outcrop and is 160 ft. long; the second tunnel is 100 ft. lower and is 430 ft. long. The two tunnels are connected by means of a raise, while 70 ft. of the upper tunnel and 250 ft. of the lower tunnel are on the vein. In an ore-shoot 70 ft. long and 18 inches wide exposed in the upper tunnel, the ore is said to run \$30 per ton in gold and silver. This shoot has been found at a point 18 ft. below the upper tunnel in a drift driven from the raise. The operators think that the shoot rakes to the south, and that the lower tunnel was just reaching it at the 430-ft. point. This was the length of the tunnel at the time of visit, August 27, 1928.

The mine was equipped with a compressor of one drill capacity driven by a 15-h.p. gasoline engine, jackhammers, stoping machines, track and car. A 10-stamp Straub mill with amalgamating plates was to be installed immediately. This is to be driven by a 16-h.p. gasoline engine. A 6 by 8 inch Straub crusher and 1200 feet of inclined tramway of 8-lb. rails are also to be installed. About five men were employed.

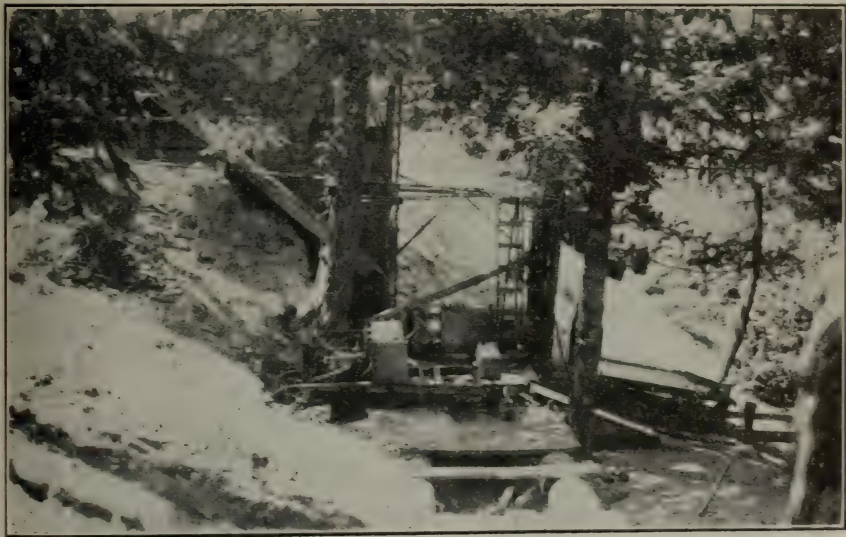
*Blue Bell Group.* Owners, M. L. Harris of Susanville and C. L. Musgrope. Location, Secs. 24 and 25, T. 29 N., R. 11 E.,  $7\frac{1}{2}$  miles south of Susanville. Four claims are held. Two surface cuts expose 4 to 10 ft. of quartz and leached material heavily stained by iron



and manganese oxides. This mixture is said to assay \$4 to \$8 per ton in gold according to samples and also according to test runs made through the Ellis ball-mill on the Gold Belt property nearby. Some experiments were made with an arrastra driven by means of a motor truck with wheels jacked up; but the operation was unsatisfactory on account of the dies wearing out very quickly.

*Gold Belt Mine.* Owner, Geo. N. McDow of Susanville. Location, Sec. 23, T. 29 N., R. 11 E.,  $7\frac{1}{2}$  miles southwest of Susanville by a good graveled road. A vertical vein in granite, consisting of mixed quartz and decomposed granite, strikes S.  $24^{\circ}$  W. A tunnel about 90 ft. below the outcrop has been driven on the vein for a distance of 200 feet. Twelve hundred feet south of this tunnel is a cut on a vein 4 ft. wide. The cut is 20 ft. long and 6 feet deep; and the ore exposed is said to average \$5 per ton. Descriptions of this property are to be found in Reports X, XII and XV of the State Mineralogist.

M. L. Harris and Henry Webster have been milling the best 18 inches of ore from the vein in the main tunnel during the summer. The mill consisted of a 4 by 6 inch crusher and a 2 by 4 ft. Ellis ball mill with amalgamating plates. Gasoline engines furnished the power. The mill did not give satisfaction, probably because the product of the crusher was too coarse for the ball mill. It was being dismantled at the time of visit in August, 1928.



Small Mill at Gold Belt Mine.

*Hayden Hill.* No work was being done at the old camp of Hayden Hill at the time of the visit to Lassen County, and it was not visited. Former reports on this district state that the ore there is all secondary. A. K. Wylie of Alturas states that some primary ore has recently been found there in work on the 250-ft. level of the Hoyt shaft on the Brush Hill claim. He says that a drift that was run 50 ft. from the shaft exposed 4 to 12 inches of solid, white quartz assaying from



Burroughs and Raker quarry at Susanville.



Gymnasium at high school at Susanville.  
(Built of stone from Burroughs and Raker quarry.)



\$80 to \$185 per ton. This work was done in 1924 and 1925. Steve Owens, who owns a ranch near Adin, has also done some work at Layden Hill recently.

*Princess Gold Mining Company.* Geo. B. Thatcher, president, Reno, Nevada; C. E. Boswell, secretary, Reno, Nevada. Location, Secs. 5 and 6, T. 26 N., R. 15 E. Milford is the nearest town, and Doyle, the nearest point on the railroad, is 19 miles southeast. A steep mountain road from the Genesee Valley connects with the highway from Susanville to Reno about a mile north of the property. A quartz vein 2 ft. to 4 ft. wide is developed by two shafts 700 feet apart. One of these is 60 ft. deep, the other 30 ft. deep.

*Satica Prospect.* Owner, Robert Satica. Location, Sec. 24, T. 29 N., R. 11 E., five miles southwest of Susanville. This prospect is on the Satica Ranch, which contains a total of 540 acres. A cut 20 ft. long and averaging 6 ft. deep exposes 2 to 3 ft. of quartz that pans well in gold. The strike is S. 15° W. and the dip 83° E. The vein pinches out at the north end of the cut. The walls are decomposed granite, and the vein is largely of the same material, but contains veinlets of quartz with a manganese stain. About  $\frac{1}{4}$  mile east of this cut is a tunnel 100 ft. long. At the time of visit, two men were driving this ahead to crosscut a similar vein that outcrops on the hill above. Chas. Gaynon of Susanville owns five claims adjoining.

#### MINERAL SPRINGS

The following mineral springs have been described in more detail by Tucker<sup>1</sup> and by Waring<sup>2</sup> and analyses of the water have been made for many of them. These will be found in the references given.

*Amedee Hot Springs* are at Amedee in Honey Lake Valley. The water is saline, and the temperature is 172° to 204° F.

*Bassett Hot Spring* is  $2\frac{1}{2}$  miles east of Bieber in Big Valley. A sulphate water flows at a rate of 175 gallons per minute. The temperature is 173° F.

*Highrock Spring* is 10 miles southeast of Amedee. The flow is 525 gallons per minute, and the water is used for irrigation.

*Shaffer Hot Springs* are at Hot Springs Station on the Nevada, California and Oregon Railroad. Temperature is 204° F.

*Stone Breaker Hot Springs* are eight miles southeast of Bieber in Big Valley. Temperature is 165° F.

#### STONE INDUSTRY

*Burroughs and Raker Quarry.* Owners, Mrs. Gladys Burroughs and Mrs. Ivy Raker of Susanville. Location, Sec. 31, T. 30 N., R. 12 E., on the edge of the town of Susanville. The gymnasium of the high school at Susanville is built of this stone, which is a rhyolitic tuff.

*Greig Quarry.* Owner, James Greig of Susanville. Location, Sec. 18, T. 29 N., R. 12 E., five miles south of Susanville by a good graveled road. A small amount of granite is quarried and is cut into corner stones and tomb stones at a shop in Susanville.

<sup>1</sup> Tucker, W. B., Report XV of the State Mineralogist, p. 236.

<sup>2</sup> Waring, G. A., U. S. Geol. Survey, Water Supply Paper 338.



**MODOC COUNTY**

CHAS. VOLNEY AVERILL, Mining Engineer

**Geography.**

Modoc County is located in the extreme northeastern corner of the state, with the state of Oregon adjoining to the north, and the state of Nevada to the east. The population is about 6000 persons, of which 1500 live at Alturas, the county seat. This will be increased very soon, because of the new industries mentioned below, which are now starting. A small part of the Modoc Lava Beds National Monument is in Modoc County, but the bulk of it is just to the west in Siskiyou County. A tract of about 75 square miles within the National Forest has been set aside because of the interesting volcanic formations, including lava vents and pipes, also caves containing ice in which the bones of animals have been embedded for many centuries. Writings of some ancient race of Indians are found carved in the rocks of these caves and in the rocks on the shore of Tule Lake nearby.

**Topography.**

Plateaus and rolling hills at elevations of 4000 to 6000 feet are characteristic of most of Modoc County. Forest covers these in large part, and, with the Warner Mountains, they make up the Modoc National Forest. The Warner Mountains rise to a maximum elevation of nearly 10,000 feet, and trend in a northerly and southerly direction across the entire eastern end of the county. Surprise Valley, a belt of nearly level land with the same trend as the mountains, extends from their base to the Nevada state line. The elevation of this valley is 4700 feet. A chain of shallow lakes, which become dry in the summer, occupies a large part of the area of this valley. Along the northern boundary of the county are similar lakes, such as Goose Lake and Tule Lake, which extend into Oregon. Pit River drains the hills and plateaus west of the Warner Mountains, while the eastern slope of the mountains drains into the shallow lakes of Surprise Valley.

**Climate.**

The four distinct seasons of a typical mountain climate bring a large number of dry, clear days. The summer temperature rarely rises above 90° F., but zero weather and below must be expected in the winter. Snow covers the higher portions for many months of the year; but it usually stays for only a few days at a time in the valleys. The annual precipitation is 14 inches at lower elevations, but is greater in the mountains.

**Industries.**

Stock raising has been the leading industry of the county, but lumbering is rapidly coming to the front. Farming is important, and some dry farming is done, but for good results irrigation must be used. In 1926 there were 59,000 head of cattle of beef breeds, 3600 head of dairy stock, 83,000 grown sheep and 9000 horses and mules. All kinds of hay, including alfalfa, are raised, and there is an important production of alfalfa seed. Oats, wheat, barley, rye, deciduous fruits and sugar beets are also raised. A number of storage reservoirs have been built; and 200,000 acres of land are under irrigation. In

Surprise and Goose Lake valleys, good flows of water are obtained from artesian wells.

Merchantable timber amounts to  $3\frac{1}{2}$  billion feet in national forests and  $6\frac{1}{2}$  billion feet privately owned. Western yellow pine comprises 75% of this. The Pickering Lumber Company is reported to have contracted to log 15,000 acres of timber before June, 1929, in an effort of the government to control the spread of a beetle that is attacking the timber. A mill of 20,000 feet daily capacity is being constructed to cut out lumber and ties. For more extensive operations a larger mill will be erected, perhaps at Alturas.

## MODOC COUNTY, 1880-1927.

Year	Gold, value	Silver, value	Salt		Miscel- laneous stone <sup>1</sup> , value	Miscellaneous and unapportioned		
			Tons	Value		Amount	Value	Substance
1880.....	\$10,000							
1881.....	20,000	\$1,500						
1882.....								
1883.....	50,000							
1884.....	60,000							
1885.....	60,000							
1886.....								
1909.....	"							
1910.....	5,438	75						
1911.....	19,875	363						
1912.....	27,893	494	50	\$800				
1913.....	6,061	94	40	720				
1914.....	1,000	10	40	720				
1915.....	7,557	104	"		\$300		\$720	Other minerals.
1916.....	2,729	90	"		200		540	Other minerals.
1917.....					200			
1918.....	"	"	"		200		8,020	Gold, salt, silver.
1919.....	6,478	390	"		550		1,802	Other minerals.
1920.....	"	"	"		700		3,968	Gem material (Iceland Spar) gold, salt, silver.
1921.....			"		34,930		1,720	Gem material (Iceland Spar) and salt.
1922.....					"		16,018	Salt, stone, miscellaneous.
1923.....	"				8,109		288	Gold, silver.
1924.....					"		1,300	Salt, stone, miscellaneous.
1925.....							2,400	Salt, stone, miscellaneous.
1926.....	158	"			36,450		1,380	Other minerals.
1927.....					61,651		600	Other minerals.
Totals..	\$277,189	3,123	*130	\$2,240	143,290		38,756	

<sup>1</sup>Includes crushed rock, rubble, sand, gravel.

<sup>2</sup>Included under Lassen County production.

\*See under 'Unapportioned.'

## Transportation.

Transportation has been greatly improved during the past year by the change from narrow gauge to broad gauge of the Nevada, California and Oregon Railroad. Further improvement is now under way in the construction of the Modoc Northern from Klamath Falls, Oregon, to Alturas. Grading of this road has been completed from Klamath Falls to Merrill near the California-Oregon line, and the contract has been let for the balance of the distance to Alturas. Surfaced highways cross the county from east to west and from north to south; and other roads reach within a few miles of any point in the county.

## Geology and Mineral Deposits.

All of the rocks and deposits of Modoc County are of Tertiary or Quaternary age. These formations are, without question, less favorable

to the development of valuable and deep-seated deposits of mineral than the older formations of the Sierra Nevada and other parts of California. But this may have been over-emphasized, and the common conception of Modoc County as a region of lava beds has perhaps discouraged prospecting. The fact is that many of the formations of this county bear a strong resemblance to the Tertiary formations of the state of Nevada, in which occur important deposits, such as those of Tonopah and Goldfield. Some rather promising prospects have been found in the Warner Mountains; and, in 1910, the High Grade district was quite active, but available capital was exhausted, as is so often the case, in the construction of mills rather than in the development of the mines. The earlier work on these prospects and the geology of the district have been described by Tucker<sup>1</sup> and by Hill.<sup>2</sup> The table herewith gives the total recorded mineral production of the county. Recent developments are described below.



Dixie Queen Mine. Big Four Mill at left.

#### COPPER

*Seitz Copper Mine.* Tucker<sup>3</sup> describes this as a series of narrow veins in andesite, located seven miles south of Fort Bidwell. The ore carries cuprite, malachite, azurite, and native copper; and some ore has been shipped from the property. There has been no recent activity here.

#### GOLD

*Discovery Claim.* Owner, James Kafader of Fort Bidwell. Location, Sec. 14, T. 47 N., R. 15 E., nine miles east of Fairport on the Nevada, California and Oregon Railroad, or nine miles northwest of Fort Bidwell. One claim of 20 acres is held. A 2-ft. quartz vein, strike

<sup>1</sup> Tucker, W. B., Report XV of the State Mineralogist, 1915-1916.

<sup>2</sup> Hill, J. M., U. S. Geol. Survey, Bull. 594.

<sup>3</sup> *op cit.*



N.  $70^{\circ}$  W., dip  $67^{\circ}$  S., with walls of dark, fine-grained green andesite, is developed by means of short tunnels and cuts.

*Dixie Queen*, formerly *Big Four*. Owners, Matt J. Holt, New Pine Creek, Oregon, and Wm. D. Nance, Reno, Nevada. Location, Sec. 1, T. 47 N., R. 15 E., nine miles east of Fairport on the Nevada, Cali-



Buildings on Klondike group—Above, shaft house; below, living quarters.

fornia and Oregon Railroad by a fair mountain road. Seven claims are held. A 45-ft. incline shaft and a 12-ft. vertical shaft are connected by about 40 ft. of crosscut. These workings are in soft, oxidized ore



heavily stained by iron oxides, and said to contain \$15 per ton in gold. Several open cuts are in the same kind of material. The country rock is rhyolite. The old mill of the Big Four Mining Company is on the property; but it is in a dilapidated condition.

*Klondike Group.* This is a consolidation of claims including those formerly called the Evening Star and Alturas. A total of 15 claims are held. Owner, W. D. Broaddus of Fort Bidwell. Location, Secs. 1 and 12, T. 47 N., R. 15 E. and Secs. 6 and 7, T. 47 N., R. 16 E., nine miles east of Fairport on the Nevada, California and Oregon Railroad by a fair mountain road. Fort Bidwell is nine miles southeast by a similar road.

On the White Quartz claim, a 50-ft. shaft has been sunk on a vein striking E. and W. with a dip of 80° N. It starts on 12 inches of quartz, which widens to 30 inches in the bottom. Broaddus says that a 30-inch sample from the bottom assayed \$7.20 in gold, and that bunches found on the way down ran as high as \$250 per ton. Walls are silicified rhyolite containing quartz stringers.

On the Klondike claim, there is a 90-ft. vertical shaft with the following equipment in good condition: 20-h.p. boiler, 12-h.p. Byron Jackson engine belted to 6 by 6-inch Rix compressor (2-cylinder), Cameron pump 6 by 3 by 7-inch, 2-cylinder hoist 6 by 6-inch, jackhammer, blacksmith tools, steel car and rails. These are housed in a building 46 ft. by 26 ft. which also covers the shaft. A vein 2-ft. wide with E. and W. strike and vertical dip was followed. The vein contains many open cavities. Broaddus says that the upper 75 feet of this vein averages \$20 per ton in gold, with bunches running \$150. The vein narrows in the bottom of the shaft, and does not sample as well as above. This condition may be only local, and further sinking seems justified. The country rock is rhyolite. Open cuts 50 feet east of this vein expose a parallel vein 3 to 4 ft. wide, said to average \$5 per ton. Another E.-W. vertical vein on this claim is developed by a 65-ft. shaft and cuts with about 40 ft. of drifts.

Three hundred tons of ore from this property were treated in an arrastra, a few years ago. Living quarters for 8 or 10 men are on the property. A good supply of water comes from springs and from the creek. The claims are in the Modoc National Forest; and there is a good stand of timber.

*Kohrnor*, formerly the *North Star*. Owners, Lawrence Sweeney and James Kafader of Fort Bidwell. Location, Secs. 13 and 14, T. 47 N., R. 15 E., 10 miles northwest of Fort Bidwell by a fair mountain road. One claim is held. A tunnel strikes a quartz stringer zone 25 ft. from the portal. A short drift follows this stringer zone, which has a width of 2½ to 3½ feet, strikes E. and W., and dips 60° S. The walls are a fine-grained, green rock, probably andesite. A few feet beyond the vein, the tunnel passes into a very dark-colored, fine-grained rock. The quartz contains some horn silver and some blue stain, probably due to small amounts of copper. Small crystals of amethyst quartz are common, also spots of iron oxides. The vein has been traced a total distance of 1400 feet by means of croppings and short tunnels.

*Lost Cabin Mine (Hess).* Owner, A. K. Wylie of Alturas. Location, Sec. 33, T. 41 N., R. 9 E., 28 miles west of Alturas. N. H. Getchell of

Battle Mountain, Nevada, is leasing the property. Report XV of the State Mineralogist, p. 251, describes former operations at this mine. The vertical shaft described in that report has recently been sunk from the 140-ft. level to the 225-ft. level, with a 10-ft. sump. This sinking was through soft material requiring spiling. A crosscut was then run 60 ft. in a northeasterly direction to the vein. At the time of visit in October, 1928, a drift on the vein had been run 10 ft. in a northwesterly direction. The vein consists of a soft mixture of wall rock, gouge and quartz. The drift showed a width of four feet of this material with a strike of N. 42° W. and a dip of 55° southwest. The hangingwall rock is altered to such an extent that it is very soft. Rock from the footwall has a dark green groundmass with phenocrysts of albite and hornblende and an occasional crystal of quartz; it is probably andesitic. Veinlets of secondary quartz were observed in this rock.



Working shaft at Lost Cabin Mine.

A. K. Wylie states that the old incline shaft went to a depth of 300 ft., that an east drift was driven 150 ft. on the 150 level and another 160 ft. on the 250 level, and that the distance from the old shaft to the present shaft is 480 ft., leaving 320 ft. of unworked ground. Mr. Wylie has done some surface work on the vein, which he says shows the vein to be 4 ft. wide at a point 200 ft. west of the old workings; and at a point 350 ft. west of the old workings, he obtained the following samples: 4 ft., \$26; 2 ft., \$36, and 2 ft. \$18. Production to date is said to be \$150,000 of ore of an average value of \$15 per ton.

Equipment consists of a Chicago pneumatic hot-head compressor with a capacity of three drills, a 2-h.p. starter compressor and a Fairbanks Morse 15-h.p. hoist. The old mill, described in Report XV of



this division as consisting of a 6 by 8-inch Dodge crusher, 10 stamps weighing 500 lbs. each and a 20-ton cyanide plant, is still on the property, but is partly dismantled.

*Modoc Mine.* Report XV of this division describes this as consisting of 259 acres of patented land in Sec. 36, T. 48 N., R. 15 E. This has recently been bought by R. R. Baker and others of Alturas at a tax sale.

*Moonlight, formerly Sunset.* Owners, J. Williams and Wm. Crow of Fort Bidwell. Location, Secs. 11, 12, 13, 14, T. 47 N., R. 15 E., nine miles northwest of Fort Bidwell. Several hundred feet of workings have been driven from a lower tunnel, which is now partly caved at a point about 150 feet from the portal. In the part of the tunnel not caved, a quartz vein less than one foot wide was observed. The walls are andesite. Upper workings, consisting of a shaft 15 ft. deep and a shaft 60 ft. deep, expose a 2-ft. quartz stringer zone in a light-colored rhyolitic breccia. The strike is E. and W., and the dip 60° S. The quartz contains open cavities, and some of it shows free gold.

*Sweeney Prospect.* Lawrence Sweeney and David Fox of Fort Bidwell have a prospect on the southeast slope of Bidwell Peak, just above the floor of the north end of Surprise Valley. This was not visited by the writer. Sweeney says that a 200-ft. tunnel in brown rhyolite cuts through three quartz veins, up to 3 ft. wide, with a northerly and southerly strike and a steep dip to the west. The ore carries copper, gold and silver, a picked piece assaying \$137. Average samples are said to assay \$10 to \$15 in gold and silver and 1% copper. The content of silver was about 3 oz., which was valued at 50¢ per ounce.

*Williams Prospect.* Owner, J. R. Williams of Alturas. Location, Sec. 19, T. 43 N., R. 14 E., on the Williams ranch one-half mile south of the road from Alturas to Cedarville, at a point 10 miles from Alturas. J. R. Williams states that, in 1921, a shaft was sunk to a depth of 80 ft. on a vein that assayed as high as \$120 in silver and gold. An examination shows that two shafts were sunk about 25 feet apart. Water now stands in these within a few feet of the surface. The dump material indicates that a shear zone containing bunches of quartz with some sulphides was followed. Some pieces of this have a high content of lime. Samples of quartz taken from the dump, and sent to the laboratory of this Division, show only a low content of gold and silver. The country rock is andesitic.

#### MINERAL SPRINGS

Hot and warm springs are common in Modoc County; and many of them are used for irrigation and for domestic purposes. Waring<sup>1</sup> of the United States Geological Survey has described the following:

*Allen Warm Springs,* nine miles west of Alturas on the Alturas-Adin road. The flow is at the rate of 275 gallons per minute of slightly mineralized water of the alkaline type, with a temperature of 81° F.

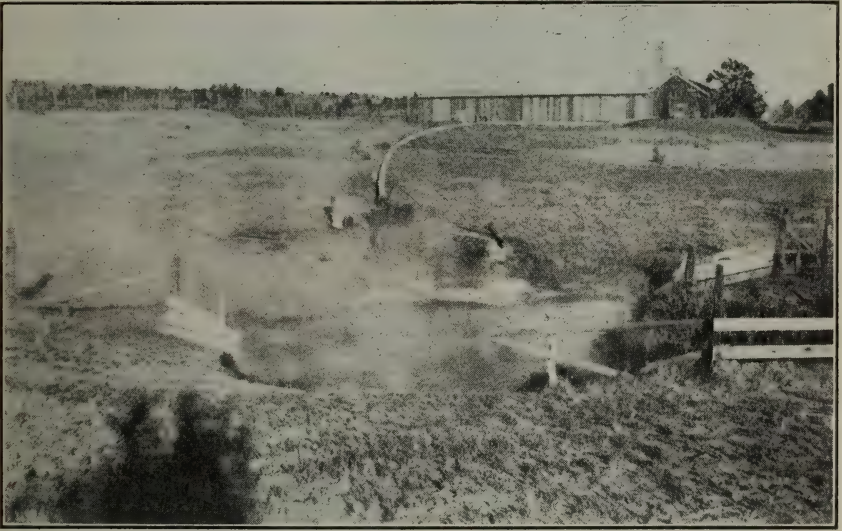
*Boyd Spring.* This is located near the eastern side of Upper Lake in Surprise Valley. The temperature of the water is about 67° F.; and it is used for irrigation on the ranch of Wm. Jacobs of Lake City.

<sup>1</sup> Waring, G. A., U. S. Geol. Survey, Water Supply Paper 338, Springs of California.



*Kelly's Hot Spring.* Owner, T. L. Chambers. Location, Sec. 29 T. 42 N., R. 10 E., on the state highway about 20 miles west of Alturas. The discharge is 325 gallons per minute, and the water is boiling. It has a slight odor of hydrogen sulphide; and in the ditch below the spring, where it has been cooled by exposure to the atmosphere, it forms a pink deposit of about the color of cinnabar. The owners say that the deposit has been tested, and has been found to contain mercury. Land irrigated with water from this spring produces 100 to 125 tons of hay per year. A concrete swimming tank has recently been built near the highway; and water is pumped from the spring to this. The new railroad from Klamath Falls to Alturas will pass near the spring. The convenient location near both the highway and this railroad indicates a possible value as a resort.

A few notes on *other springs* that have not been named follow: About eight miles north of east from Kelly's Hot Spring, a stream



Kelly's Hot Spring.

named Hot Creek is formed by a number of hot springs that rise on the north side of the valley that borders Pit River. Near the head of Canyon Creek, a stream flowing into Pit River from the south at a point about midway between Alturas and Canby, are a number of warm springs. On the west side of Bidwell Creek, about a mile north of Fort Bidwell are some hot springs, which are used by Joe Martin and M. M. Martin to feed a swimming pool. This is a concrete tank 50 by 30 feet. Hot springs are found also a few miles north of Lake City and on the east side of Surprise Valley.

#### STONE

The volcanic tuffs of Modoc County afford a supply of stone, of many different colors and shades, that is easily cut to size and shape for building purposes. The high school and the office building of the Nevada, California and Oregon Railroad at Alturas, and several



Buildings of cut stone from Modoc County—Above, High School at Alturas; below, offices of Nevada, California and Oregon Railroad at Alturas.

mer buildings have been constructed of cut stone of this kind. Following are the names of the owners and the locations of the quarries: H. Sisson, P. S. Dorris and W. J. Dorris of Alturas have a quarry Sec. 22, T. 42 N., R. 12 E. Ivy S. Raker of Susanville has a quarry Secs. 22, 27 and 28, T. 42 N., R. 12 E. B. L. Kelly of Alturas has a quarry in Sec 7, T. 42 N., R. 12 E. W. E. Minard of Alturas has a quarry in Secs. 14 and 23, T. 42 N., R. 12 E., from which the mottled stone used in the construction of the N., C. & O. office building was taken.

## SAN FRANCISCO FIELD DIVISION

C. McK. LAIZURE, Mining Engineer

On account of unfinished field work there is no report from the San Francisco Field Division in this issue.





## LOS ANGELES FIELD DIVISION

W. BURLING TUCKER, Mining Engineer.

## KERN COUNTY

## Introduction.

Kern County, because of its immensely productive oil fields, for many years was the leading mineral producing county of California. Kern County was surpassed in its mineral output by Los Angeles County only, in 1924-1926, due to the increased production of petroleum from the latter county. The county was organized in April, 1866, and comprises 8003 square miles. It is the third largest county in the state, and is bounded on the north by Tulare, Kings and Inyo, on the south by Los Angeles and Ventura, on the east by San Bernardino, and on the west by San Luis Obispo. The development of the petroleum industry since 1900 has increased the mineral production to a great extent. Other outstanding development of minerals is the production of gold in the Randsburg District, and the discovery in the past few years of new borax deposits near Kramer that will add materially to the mineral wealth of the county.

## Topography.

The eastern and southern portions of the county contain the southern end of the Sierra Nevada Range, and this range merges with the Coast Range at Tehachapi. Its western boundary is along the summit of the Coast Range, and the southern end of the San Joaquin Valley makes up about one-third of the county's area. The southeastern slopes of the Sierra and a large portion of the Mojave Desert are included in the southeastern part. The county thus includes the slopes of two mountain ranges and a large and fertile valley plain, and an arid desert region. Along the northwestern border is the Diablo Range rising to a height of from 2000 to 3000 feet. From the junction of the Sierra Nevada and the Coast ranges, the San Emedio Mountains project 20 miles northward into the valley.

## Streams.

Kern River and Poso Creek are the principal streams of the county. The Kern River rises among the highest peaks of the Sierra Nevada Range, in the northeastern part of Tulare County, having two large forks flowing southwesterly 125 miles. This river is one of the important streams of the state for the generating of hydro-electric power. It enters the San Joaquin Valley near Bakersfield, then flowing westwardly, divides into many channels. This river supplies much of the water for irrigation purposes for the fertile lands of the valley.

Poso Creek has its source in many branches high up in the Greenhorn Mountains, and flows southerly some 25 miles, then westerly and southwesterly until it sinks in the valley, after a winding course of 75 miles.

## Climatic conditions.

Mining operations can be pursued throughout the entire year, as the snowfall, even in the mountain regions, is not heavy enough to interfere with the work. In the valley the rainfall amounts to about 8 inches per year. The temperature in July and August may reach 110°F.

## KERN COUNTY—MINERAL PRODUCTION 1880-1927.

Year	Asphaltum		Brick		Copper		Fuller's earth		Gold, value	Lime		Limestone		Silver, value	Natural gas		Petroleum		Miscellaneous and unapportioned		
	Tons	Value	M	Value	Pounds	Value	Tons	Value		Barrels	Value	Tons	Value		M cu. ft.	Value	Barrels	Value	Amount	Value	Substance
1880									\$94,214					\$390							
1881									190,000					14,000							
1882									260,000					20,000							
1883									150,000					5,000							
1884									100,000					5,000							
1885									72,003												
1886									94,840					1,721							
1887									72,358					150							
1888									60,000					2,500							
1889									242,876					7,517							
1890									117,341					586							
1891									107,735					61							
1892									107,738					73							
1893									83,665					1,754							
1894	6,900	\$138,000							310,707	33,000	\$26,500			39,700			11,215	\$69,334	92 tons	\$3,720	Antimony.
1895	1,400	28,000							231,433	25,400	24,980			46,064			116	116	33 tons	1,485	Antimony.
1896	2,484	44,580							590,867	37,100	32,320	5,000	\$10,000	34,650			235	235	15 tons	2,250	Antimony.
1897	4,650	86,350	1,100	\$6,600					754,313	53,400	70,370			10,471					25 tons	3,500	Antimony.
1898	1,850	50,000	2,000	14,000					1,017,930	42,000	29,900			6,543			10,000	10,000	220 tons	1,100	Coal.
1899	2,537	57,670	1,600	11,400			620	\$12,400	863,414	64,700	57,690			6,810					40 tons	1,200	Antimony.
1900	701	14,020	2,525	17,300	4,000	\$750	500	3,750	805,252	57,721	51,700			147,736			15,000	13,500	27 tons	3,382	Borax.
1901	3,112	43,120	4,600	23,400	429,248	67,606	1,000	19,500	1,007,059	62,000	82,700			40,497			919,275	827,348	859,927		Unapportioned, 1900-1909.
1902	10,150	101,500	3,500	24,500	235,840	27,122	987	19,246	1,165,982	99,360	80,856			90,135			3,902,125	1,131,616	1,600 lbs.	64	Lead.
1903	8,006	100,787	9,000	30,000	4,300	559	250	4,750	1,022,353	101,661	76,246			114,614			9,777,948	1,955,585	50 tons	8,350	Antimony.
1904	12,451	124,110	700	4,900			500	9,500	1,426,523	178,038	172,000			151,189			18,001,148	3,600,230	1,000 tons	8,000	Gypsum.
1905	10,586	105,860	750	6,000					1,160,971	279,650	255,500		44,000	134,944			19,608,045	3,431,408	28 tons	63	Bituminous rock.
1906	23,136	231,360	4,275	34,200					806,117	293,613	267,096			129,503			17,069,715	3,174,966	1,000 tons	5,500	Gypsum.
1907	20,443	260,158	2,168	18,428					878,798	175,000	169,822			86,033			15,700,308	4,673,867	500 tons	2,000	Gypsum.
1908	50,000	475,000	2,080	19,552					827,087	116,717	87,788			96,550			18,777,871	9,388,935		500	Gems.
1909	54,599	655,391	3,363	20,634			350	5,385	654,799	115,709	88,869			101,633	38,000	\$2,714	24,549,758	12,565,246		3,300	Gypsum.
1910	76,605	811,846	8,332	63,711					619,974	99,187	86,198		4,331	35,041	975,724	47,304	40,641,159	17,825,212	1,700 tons	174	Lead.
1911			5,603	41,426	29,441	3,680			557,471	96,500	82,025	600	400	5,833	1,654,380	165,438	46,562,825	20,207,906	4,781 lbs.	8,305	Gypsum.
1912			1,800	23,120					830,421	162,831	124,894			11,480	4,400,000	325,484	51,448,067	21,762,532	1,675 tons	112,000	Rubble.
1913			1,625	22,000	3,498	542			649,712	135,000	91,200			11,851	7,111,237	568,899	58,698,432	27,038,474	100,000 tons	121	Clay.
1914			3,834	29,214	7,394	983			594,337	81,600	65,100			8,002	6,508,868	390,532	65,332,633	26,721,046	230,950 tons	107,880	Crushed rock.
1915					1,047	183			983,319	55,176	39,523	1,425	1,710	13,316	12,163,461	737,638	54,810,669	23,184,913	853 tons	4,245	Gypsum.
1916			3,177	23,824	24,754	6,089	1		747,042					8,745	10,679,658	1,379,033	54,120,509	34,691,246	2,417 lbs.	109	Lead.
1917			and tile	22,785	251,225	68,584			537,852					7,813	25,819,370	1,445,880	53,065,066	47,387,104	8,479 tons	18,188	Gypsum.
1918			1,678	16,380	95,580	23,608			246,127	23,615	23,615			7,817	23,545,128	1,507,912	49,049,917	61,410,496	19,664 lbs.	885	Lead.
1919			1,709	175,112					150,589	86,952	112,724			8,402	25,363,739	1,618,913	47,734,035	64,440,947	208 tons	104	Clay.
1920			3,850	56,550	200	38			61,187	76,305	106,733			8,385	34,912,865	1,810,147	50,660,438	86,831,991	10,000 tons	22,750	Gypsum.
1921			5,840	85,820					84,698	72,629	141,491			1,897	40,136,930	1,026,797	57,434,945	97,639,407	1,376 lbs.	61	Lead.
1922			5,082	66,652					124,337					6,524	47,644,633	2,282,100	53,512,157	64,803,222	346 tons	172	Clay.
1923			5,271	68,375					107,051	17,985	214,183			33,151	42,421,592	2,051,656	45,952,794	37,629,300	82 tons	320	Gypsum.
1924			1	23,058					154,132	8,130	96,880			35,902	47,881,308	2,522,551	61,175,405	69,572,934	379 lbs.	15	Lead.
1925			1						135,545					7,455	45,640,845	2,290,608	58,852,742	84,255,094	20,000 tons	50,000	Salt.
1926			4,591	55,140					135,508					4,667	44,182,140	2,158,867	54,549,646	78,987,887	267 tons	11,301	Antimony ore.
1927			4,835	50,438					171,100					8,932	39,401,478	2,057,807	51,570,412	58,738,699	84,371 lbs.	3,965	Lead.
Totals	286,610	\$3,327,858	94,926	\$940,461	1,086,633	\$199,744	4,216	\$74,531	\$22,166,377	2,653,042	\$2,758,912		\$65,441	\$1,530,037	466,490,362	\$25,290,340	1,097,340,610	\$967,735,996		\$18,145,192	

See under "Unapportioned."





### Transportation.

Two great transcontinental railroads, the Southern Pacific, and the Santa Fe, pass through the center of the county. From Mojave the Southern Pacific operates a branch line to Owens Valley connecting with the Nevada and California Railroad at Owenyo, Inyo County. The main state highway known as the Valley Route from Los Angeles to San Francisco, passes through the county.

The productive oil fields and mining districts are connected with the highway system by good roads, the principal ones being paved.

### General Resources.

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all the counties of California in the value of mineral output, the exact figures for 1926 being \$83,556,074. During 1926 fourteen different mineral substances were produced. Among the mineral resources developed and undeveloped are antimony, asphalt, borax, brick, clay, cement, copper, feldspar, fullers earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, pumice, salt, silica, silver, soapstone, soda, sulphur, and tungsten.

## METALS

### ANTIMONY

The commonest occurrence of antimony is in the form of sulphide, stibnite, but in the Havilah and Kernville districts there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

Deposits of antimony occur on a spur of the mountains bordering Emigdio Canyon, in Secs. 10 and 15, T. 9 N., R. 21 W., S. B. B. and Sec. 1, and 10 miles west of Koehn, in Secs. 5 and 6, T. 30 S., R. 36 E., M. D. M.

Antimony, in the form of the antimony sulphide, stibnite also occurs in Sec. 4, T. 10 N., R. 15 W., 24 miles northwest of Rosamond.

### Mines.

*Antimony Consolidated Mines* comprise 20 acres located in Secs. 5 and 6, T. 30 S., R. 36 E., M. D. M., about 10 miles west of Koehn and 10 miles northeast of Mojave. Owner, Arthur Asher, of Los Angeles.

Bibl: State Mineralogist's Report XIV, p. 475.

*Mahary and Houghawoth Group of Claims.* This group comprises four claims situated in Sec. 4, T. 10 N., R. 15 W., 24 miles northwest of Rosamond. The sulphide of antimony, stibnite, occurs on the contact of limestone and porphyry. The vein strikes east with a dip to the north.

Development consists of a shaft 30 feet deep. In this shaft a lens of ore has been exposed, which shows a width of 12 inches to two feet. The ore mined is said to carry 20% antimony. Idle.

Bibl: State Mineralogist's Report XX, p. 367.

*Rayo Mine.* It comprises 40 acres located in Sec. 36, T. 26 S., R. 33 E., M. D. M., about 6 miles southeast of Isabella. Idle.

Bibl: State Mineralogist's Report XIV, p. 476.

*San Emigdio Mine.* It comprises 80 acres of patented land, situated in Secs. 9 and 10, T. 9 N., R. 21 W. S. B. M., about 12 miles southwest of Sunset. Owner, Kern County Land Company, of Bakersfield. Idle.

Bibl: State Mineralogist's Report XIV, p. 476; X, p. 225; and VIII, p. 680.

*Tom Moore Mine (Erskine Creek Mine).* It comprises 10 acres of patented land, situated in Sec. 24, T. 27 S., R. 33 E., M. D. M., about 36 miles north of Caliente in the Valley View Mining District. Owner, Kern Development Company, Kernville, California. Idle.

Bibl: State Mineralogist's Reports X, p. 237; XIV, p. 476.

#### ARSENIC.

Arsenic is found in a number of localities in the mineral, arsenopyrite ( $\text{FeAsS}$ ); and as scorodite ( $\text{FeAsO}_4 \cdot 2\text{H}_2\text{O}$ ), an oxidation product of arsenopyrite.

*Contact Mine.* It comprises three claims: Contact, Music and Teller Horse, a total of 60 acres, situated in Sec. 10, T. 10 N., R. 15 W., 16 miles northwest of Rosamond, on the south slope of Pine Mountain. Owner, B. D. Standefore, of Rosamond. Under lease to J. H. Fell and C. Gross, of Los Angeles.

Country rock is limestone and shale. The ore occurs in small, irregular lenses in shale, along an intrusion of diorite in the vicinity of the contact between limestone and shale. The ore is arsenopyrite, associated with pyrite. Width of ore varies from 6 to 12 inches. The vein strikes east and dips  $80^\circ$  north.

Development consists of a vertical shaft 50 feet deep with a drift west for a distance of 20 feet; also a tunnel driven east along the vein for 50 feet. It is reported that 27 tons of ore was shipped in 1921, the average assay value being 40% arsenic. Idle.

Bibl: State Mineralogist's Report XX, p. 368.

#### COPPER.

The occurrences of copper ores in the county are few and widely separated and, therefore, one is hardly warranted in identifying them with the foothill copper belt that terminates in a vague way in Kern County.

The copper deposits that have attracted attention are located near Woody and Kernville; on the western Sierra slope; in the Rademacher Mining District; on the southeastern slope of the Sierras; on the northern edge of the Mojave Desert, in the El Paso Range north of Randburg. In the neighborhood of Walker's Pass, between Kernville and the Rademacher, copper minerals are found. At present there is no active mining of copper ore in the above-mentioned districts.

*Greenback Copper Mine.* It is the largest copper mine in Kern County and is located in Secs. 1, 2, 3, 4 and 10, T. 26 S., R. 29 E., M. D. M., in the town of Woody, 32 miles northeast of Bakersfield. It comprises 500 acres. Owner, Weringer Mines, Corp. I. Weringer of Woody, California. The property was located in 1890 by I. Weringer.

nger and operated from 1916 until August, 1917. A mill having a capacity of 100 tons was installed on the property but after operating a short time operations were suspended. The plant was dismantled and sold.

Six parallel veins occur in granodiorite, the average width of these veins being 30 feet. The veins strike northeast and southwest, dip  $60^{\circ}$  north. The oxidized zone extends to a depth of 60 feet, where the sulphide zone was encountered. The ore consisting of chalcopyrite and chalcocite, associated with iron pyrites, occurs disseminated throughout the granodiorite. The ore formerly mined is stated to have averaged 2% copper.

Workings consist of an incline shaft 200 feet deep and a vertical shaft 240 feet in depth, with levels at 100', 140' and 200'. On the 200-foot level there is 1200 feet of drifts. A winze 200 feet in depth has been sunk on an incline of  $45^{\circ}$  in the main orebody on the 200-foot level. It is stated that 100,000 tons of 2% copper ore was developed in the mine. Idle.

Bibl: Bull 50, p. 297; State Mineralogist's Reports XIV, pp. 479-480, XVII, pp. 307-308.

*Layman Group of Copper Mines.* These mines are situated in the Goler Mining District, 6 miles northwest of Garlock, a station on the Southern Pacific Railroad. Owner, James M. Layman, of Los Angeles.

A series of parallel quartz veins occur in schist, which are mineralized with chalcopyrite, associated with pyrite. The veins strike north and south, dip  $45^{\circ}$  to  $60^{\circ}$  east. The widths of the different veins vary from 3 to 6 feet. The ore mined is reported to carry from 3% to 6% copper with values in gold and silver.

Development consists of an incline shaft 100 feet deep, prospect shafts and short tunnels. Idle.

Bibl: State Mineralogist's Report XVII, p. 308.

*Orange Blossom Group of Claims.* It comprises two claims located 2 miles north of Gypsite, on the southeast slope of the El Paso Mountains. Elevation 2750 feet. Owner, Mrs. J. S. Bishop, of Cantil, California.

Copper oxide ore occurs along a shear zone, which strikes N.  $25^{\circ}$  W. and dips  $70^{\circ}$  south. Five lenticular outcrops of iron gossan occur at intervals along the shear zone. These iron gossan outcrops are 20 to 50 feet in length, and from 6 to 20 feet in width. The formation is limestone and quartzite.

Development consists of a number of opencuts made on the different gossan outcrops, and a tunnel driven 60 feet northwest. The ore is mainly bornite, with some malachite and azurite. Idle.

*Walsh and McClaude Group of Claims.* Situated in the Goler Mining District adjoining the Layman Group, 5 miles northwest of Garlock. Elevation 3600 feet. Owner, W. J. Walsh; J. McClaude, of Garlock, California.

Ore occurs in lenses in a mineralized schist, carrying chalcopyrite associated with iron pyrite, there being a series of parallel veins in the schist. The veins strike northwest and southeast; dip  $60^{\circ}$  east. The veins vary in width from 3 to 6 feet.



Development consists of a number of prospect shafts and short tunnels. Idle.

Bibl: Report of the State Mineralogist XVII, p. 308.

*Walsh Group of Claims.* The claims are situated in the Goler Mining District, 8 miles northwest of Garlock. W. J. Walsh, of Randsburg, California, owner.

Ore occurs along a series of parallel quartz croppings in schist, on the north side of Sweet Home Canyon. These veins strike northwest and dip  $60^{\circ}$  east. The ore is chalcopyrite associated with iron pyrite disseminated in the schist.

Developments consist of a number of shafts 50 to 100 feet in depth, and a tunnel 100 feet in length. Idle.

Bibl: State Mineralogist's Report XVII, pp. 308-309.

#### GOLD

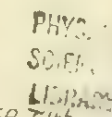
The first discovery of gold in Kern County was made by a member of General Fremont's party in 1851, at Greenhorn Gulch, near the Kern River. In 1852 the Keys and Mammoth mines were located in the Keysville District, both of which were steady producers for over sixty years. In 1861 the mines of the Cove District were discovered, the largest producer being the Big Blue and Sumner group of mines. The mines of the Cove District have a production record of \$5,000,000 to \$8,000,000. The discovery of placer gold at Goler, in 1893, led to the development of quartz mines in this section. The Yellow Aster, the largest gold producer in Southern California, was discovered by John Singleton and William Burcham in 1895, and has been worked continuously to date. The development of the Yellow Aster Mine led to the discovery of other productive mines, and caused the Rand District to be the largest producing district in the county. The total gold production from this district is about \$15,000,000.

In 1894 gold was discovered in the Mojave Mining District, which led to the development of the following productive mines: Queen Esther, Exposed Treasure, Karma, Elephant, Echo and Gray Eagle mines.

There was a revival of interest in this district in 1922 due to the discovery of high grade gold ore in a small butte north of the Exposed Treasure Mine. In June, 1922, the Yellow Dog Mining Company was organized for the development of the property. The mine has been operated on a small scale to date. The Mojave District has a production record of over \$2,000,000.

There has been some renewal of activity in the development of gold lode properties in the county during the past year. A number of the old productive mines have been reopened, which promises to increase the gold yield. The gold production from the county during the year, 1926 amounted to \$135,500. The principal production at present is from the area around Kernville, Mojave and Randsburg, the major production coming from the last-mentioned district.

*Amalie Mine.* It comprises 21 claims, 4 patented, situated in the Amalie Mining District in Sec. 22, T. 30 S., R. 33 E. M.D.M., about







3 miles northeast of Caliente. Owner, Amalie Mining Company, Bakersfield, California. Jos Enzenperger, president; Thomas Gagen, secretary.

The vein occurs in quartz-porphyry, strikes northwest and dips 40° east. Width, 10 to 12 inches. Development consists of a vertical shaft 30 feet deep with five levels, comprising over 5000 feet of work. The property is reported to have produced \$600,000. Idle.

Bibl: State Mineralogist's Reports XII, p. 141; XIII, p. 605; XIV, p. 486.

*American Golden Eagle Mine.* It is situated in the Clear Creek Mining District, in Secs. 2 and 10, T. 28 S., R. 32 E., M.D.M., 2 miles south of Havilah. Owners, Homer Bros., of Havilah. Idle.

Bibl: State Mineralogist's Report XIV, p. 486.

*Baltic Mine.* It comprises 40 acres, located in the Rand District, in Sec. 1, T. 30 S., R. 40 E., M.D.M., 1½ miles southeast of Randsburg. Elevation 3600 feet. Owner, Monarch Rand Mining Company, Randsburg, California.

The deposit consists of many small veins of quartz in a shear zone in the schist, which is about 100 feet in width. Two veins were worked through the Baltic Shaft which was sunk on an incline of 5°, to a depth of 160 feet. One of these veins strikes east and west, the other north and south, and the veins intersect near the point where the shaft was sunk. The veins vary from 2 to 4 feet in width. About 600 feet northwest of this shaft, a new shaft has been sunk to a depth of 610 feet on an inclination of 65°. Levels were cut at 300 and 580 feet. On the 300-foot level a crosscut has been driven 95 feet south, intersecting K. S. N. Vein at 55 feet. Two hundred and thirty feet of drifts were run on the vein. On the 580-foot level, crosscuts were run 112 feet to the south and 96 feet to the north, but the vein was not encountered. The vein prospected on the 300-foot level had a width of 2 to 4 feet but carries no commercial ore. The property is equipped with a 10-stamp mill and electrical-driven single-drum hoist. Idle.

Bibl: State Mineralogist's Report XIV, p. 487; Bull. 95, p. 128.

*Barbarossa Mine.* It comprises 140 acres situated in the Amalie Mining District, in Sec. 29, T. 30 S., R. 33 E., M.D.M., about 15 miles northeast of Caliente. Elevation 3600 feet. Owner, Mrs. B. G. Parlow, Loraine, California.

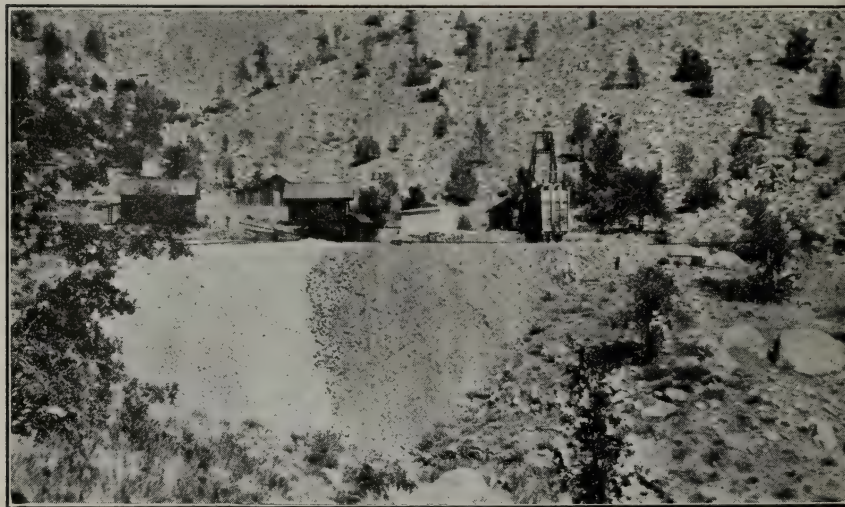
There are seven veins on the property; of these only the Barbarossa vein has been developed. This vein strikes northwest and dips 40° east. The vein has an average width of 4 feet, with a granite foot-wall and a quartz-porphyry hanging wall. Development consists of 40-foot shaft and 400 feet of drifts. Idle.

Bibl: State Mineralogist's Report XIV, p. 487.

*Beehive Mine.* It comprises 10 claims located six miles north of Randsburg, on the south slope of the El Paso Mountains. Owner, Kern Rand Mines, Inc., of Bakersfield.



Outcrop and glory hole. Big Blue-Sumner lode.  
Big Blue-Sumner Mines. Cove District, Kernville.



Beauregard Mine. North Sumner Gold Mines.  
Cove District, Kernville.



The property has been developed by four shallow shafts and approximately 400 feet of horizontal workings. Idle.

Bibl: Bull. 95, 'Geology and Ore Deposits of the Randsburg Quadrangle,' p. 128.

*Beauregard Mine.* (See North Sumner Gold Mines.) It is situated in the Cove Mining District, in Sec. 28, T. 25 S., R. 33., E., M. D. M., and three-quarters of a mile north of Kernville. Owner, Kern Development Company, Kernville, California.

*Bella Rufin Mine.* It is located in Sec. 25, T. 24 S., R. 33 E., M.D.M., in The Green Mountain Mining District, about 23 miles northwest of Caliente. Idle.

Bibl: State Mineralogist's Reports XII, p. 142; XIV, p. 488.

*Big Blue and Sumner Group of Mines* comprises the following mines: Big Blue, Sumner, Content, Mollie Dent, Orejana, Blue Gouge No. 1, No. 2 and No. 3, totaling 95 acres, situated in the Cove Mining District, one-half mile north of Kernville. Elevation 2900 feet. Owner, Kern Development Company. C. S. Long, president, Kernville, California. Under option to the Golden Center Mines, Inc., Charles V. Bob, president. Offices, 120 Broadway, New York City. W. C. Browning, consulting engineer. Local offices, Pacific Mutual Building, Los Angeles.

The above mentioned claims are located on the Big Blue-Sumner lode. The Big Blue and Sumner mines were operated by the Sumner Gold Mines Company from 1875 to 1884, during which period, according to records of this company, 151,000 tons of ore was milled with an average value of \$8.27 per ton, with a total yield of \$1,250,000. The records of later production, from 1883 to 1901, mainly from leases, show over 3700 tons of ore extracted from the 240-foot level from which \$13.43 per ton was recovered. The total production is reported to have been \$1,746,910.

H. W. Raymond in the Seventh Annual Report of the U. S. Commissioner of Mining Statistics, states: "The Sumner produced in 1874, 5000 tons of ore with an average yield per ton of \$40, total bullion produced being \$200,000. The lode underground is 80 feet wide between walls and has been opened up for 1000 feet along the vein for a depth of 160 feet. The average yield was \$18 per ton."

#### Geology and vein Systems.

The formations consist of granite, slate and schist, the former predominating. Near the granite a narrow bed of slate and schist extends north and south a distance of 8 miles and the Big Blue-Sumner lode occupies the contact. This belt of slates and schists is 1 to 2 miles in width and 15 or more miles in length. The contact with the granite is irregular in outline and the Big Blue-Sumner vein occupies a fault which has broken through the various formations along the contact line. In places the slate and schist does not show for a considerable distance east of the Big Blue-Sumner vein.

In the 2300-foot drain tunnel no slate is found, as the tunnel is in granite until it strikes the Big Blue-Sumner vein, where it forms a part of the vein. The Big Blue-Sumner vein occupies the line of a reverse fault. The vein is of great width, vein matter and quartz



showing from 80 to 125 feet in width, and this lode is traceable for several miles. The main lode has generally been regarded as composed of three veins, called the West or Hanging Wall Vein, which shows a width of 5 to 6 feet, the Middle or Big Blue vein, which shows a width of 40 feet, and the East or Footwall vein, showing a width of about 6 feet. The veinfilling between these veins is well silicified and somewhat mineralized with pyrite and in places the West and Big Blue veins merge. The Big Blue-Sumner vein strikes N. 20° W. and dips 70° west.

The present operating company started development operations on the property on October, 1927. The drain tunnel was retimbered and extended 300 feet into the granite hanging wall. This drain tunnel is driven N. 50° W. and intersects the Sumner shaft at 3000 feet from the portal. At 250 feet northwest of the shaft, a drift was driven 100 feet north and 202 feet south from this crosscut in the hanging wall granite. Five diamond drill stations were established in these drifts and diamond drill holes have been run to prove the orebody below the present tunnel level. At 1935 feet from the portal of the main crosscut tunnel, a drift has been driven 240 feet south in the footwall of the vein. At 180 feet south of crosscut tunnel, a crosscut has been driven 125 feet west to the hanging wall of the vein. At 240 feet south of drain tunnel, another crosscut has been driven through the vein 125 feet to the hanging wall. The Big Blue-Sumner vein shows a width of 125 feet in the above mentioned crosscuts. Fifteen men are employed.

Bibl: State Mineralogist's Reports VIII, p. 313; XIV, pp. 488-489; XX, p. 40; Raymond, Seventh Report U. S. Commissioner of Mining Statistics.

*Big Gold Mine (West End).* It comprises the following claims: North Star, Crechy Strike, Neglected, Kenneth B. Fraction, totaling 74 acres located in Secs. 3 and 4, T. 30 S., R. 40 E., M. D. M., 3 miles southwest of Randsburg, on the west slope of the Rand Mountains, adjoining the Minnehaha Mine on the west. Owner, Patrick Spelaine and associates, of Randsburg, California.

The county rock is granite and schist. A series of parallel quartz veins occur in the schist and there is also an east and west system of veins that intersect the north and south veins. The principal development work has been confined to the Big Gold vein, which occurs on a fault fracture along the contact of granite and schist. This vein has a course of N. 20° W., and dips 40° east. Its average width is 4 feet. The quartz carries free gold, and a small amount of pyrite. The croppings of the vein are prominent and can be traced for 3000 feet. Developments consist of a 2-compartment vertical shaft 365 feet deep. The shaft intersected the vein on the 155-foot level, the vein was drifted on 200 feet south and 30 feet north on this level. Above the 155-foot level the vein has a granite hanging wall and a schist footwall. Below this level the hanging wall is rhyolite-porphry, with schist on the footwall. A winze has been sunk on the vein from the 155-foot level to a depth of 105 feet. Drifts have been run north and south on the vein. In 1927 100 tons of ore was extracted that milled \$20 per ton. Idle.

Bibl: State Mineralogist's Report XIX, p. 166.

**Black Hawk Mine.** It comprises 130 acres, situated in the Rand District,  $2\frac{1}{2}$  miles southwest of Johannesburg. The property was discovered in 1896 and operated by D. A. B. Blue until 1921, when it was purchased by the Pittsburgh and Mount Shasta Mining and Milling Company. J. J. Schneider, president; T. V. Scott, vice president, and D. F. McCormick, manager. Offices, 516 Federal Building, Pittsburgh, Pennsylvania.

The present company started operations February 21, 1923, and the property has been under continuous development to date. Three parallel quartz veins occur in the schist, with a general north strike and dip  $50^\circ$  to the east. Width of the veins vary from 18 inches to 3 feet. Free milling gold quartz; value \$7 to \$50 per ton. Developments: Black Hawk shaft 250 feet deep with levels at 50, 100 and 200 feet, and 5000 feet of drifts and crosscuts on the Black Hawk vein.

In 1923 the company sunk two shafts in the silver producing area of the Rand District. The Pittsburgh shaft is located on the Shasta claim, 2500 feet south of the California-Rand, Inc., main shaft and 1000 feet south of the Bray-Bisbee shaft on the Rand Silver King group. This shaft was sunk to a vertical depth of 700 feet and at 140 feet passed through the Rosamond formation into the schist, and in the latter formation cut a number of N.  $30^\circ$  E. fissures which dip  $60^\circ$  to  $65^\circ$  northeast. These fissures are filled with quartz and calcite, mineralized with pyrite and some stibnite. No commercial ore was encountered and work in recent years has been confined to the gold veins on the Black Hawk. Electric power is secured from the Southern Sierras Power Company.

Mine equipment: At Black Hawk shaft, there is a 20-h.p. direct connected electric hoist; at Pittsburgh shaft, a 50-h.p. electric hoist and  $12'' \times 10''$  compressor; at the Bevis Divide shaft, a 25-h.p. electric hoist.

Mill equipment: 5 stamps, weight 1000 pounds. The ore is crushed through 40-mesh, followed by amalgamation. Ten men are employed. Total production of Black Hawk is about \$400,000.

Bibl: State Mineralogist's Reports XIX, pp. 166-167; XIV, p. 489; Bull. 95, 'Geology and Ore Deposits of the Randsburg Quadrangle,' pp. 130-131.

**Black Mountain Mine.** (Placer) It comprises 160 acres located on the south slope of Black Mountain, near the head of Last Chance Canyon, about 13 miles northeast of Cantil. Elevation 3300 feet. Owner, Black Mountain Placers, Inc., Los Angeles, California. Charles Brewer, manager.

The old river channel is exposed on the north side of Last Chance Canyon. The course of the channel is east and west, with a width of 150 feet, and depth of from 8 to 10 feet. Bed rock is sandstone. The gravel is made up of boulders of basalt, granite and quartzite. Pay gravel occurs about 3 feet above bedrock. The average value of gravel worked is said to be from 50 cents to \$2 per cubic yard.

Development consists of two tunnels driven north on the channel about 40 feet in length. The gravel from these workings is dumped over 2-inch grizzly, the minus 2-inch size goes into an ore bin having a capacity of 25 tons, the oversize being discarded. The finer material is treated on a Stebbins Dry Concentrator. The company drilled a well to a depth of 110 feet and encountered a small flow of water. Idle.



*Blue Gouge Group of Mines* consists of 350 acres located in Sec. 28 T. 25 S., R. 33 E., M.D. M., 2 miles north of Kernville. Elevation 3600 feet. Owners, Orejana Mining Co. C. S. Long, president; C. C. Hamilton, secretary, Kernville, California. Under option to Golden Center Mines, Inc., 120 Broadway, New York City.

Eight parallel veins occur in the granite, strike northeast and southwest, dip  $68^{\circ}$  to the northwest. Average width of these veins is from 4 to 5 feet. The Blue Gouge Vein has been developed by a tunnel about 1000 feet in length and a shaft 200 feet in depth.

Bibl: State Mineralogist's Reports XX, p. 40; XIV, p. 489.

*Bright Star Mine.* It is located in the Green Mountain District in Sec. 10, T. 28 S., R. 34 E., M.D.M., 34 miles northeast of Caliente. Elevation 8400 feet. Owner, Mrs. Tracy, San Francisco, California. Holdings comprise 60 acres, patented.

The vein strikes northeast and southwest, dip  $60^{\circ}$  north. Average width is 20 inches. Formation is slate.

Workings consist of a shaft 540 feet deep with three levels and several thousand feet of drifts. Reported to have produced about \$600,000. Idle.

Bibl: State Mineralogist's Report XIV, p. 490.

*Bull Run and Lady Belle Group* consists of the following claims: Bull Run, Boston Belle, Jeff Davis and Lady Belle, located in Sec. 28, T. 25 S., R. 33 E., M.D.M., in the Cove District, one-half mile north of Kernville. Elevation 2980 feet. Owner, Lady Belle Mining Company, C. S. Long, president; C. C. Hamilton, secretary, Kernville, California.

The Lady Belle-Bull Run Vein occurs in the granite and has an average width of 3 feet. Strike N.  $75^{\circ}$  E., dip  $62^{\circ}$  north. The vein has been developed by a shaft 380 feet deep sunk on the vein. Four levels have been driven east and west on the vein, amounting to several thousand feet and three stopes 200 feet in length. The ore shoot developed is reported to have been 250 feet long with an average width of 3 feet.

On the Bull Run Claim there is an incline shaft 360 feet deep, with seven levels, several thousand feet of drifts and crosscuts and one stope 900 feet in length.

On the Jeff Davis Claim, a vein of quartz 12 inches wide occurs in the granite and is parallel to the Bull Run-Lady Belle Vein. Strike N.  $75^{\circ}$  E., dip 70 to  $75^{\circ}$  north. Workings consist of shaft 200 feet deep. Idle.

Bibl: State Mineralogist's Reports XX, pp. 40-41; XIV, pp. 490, 498 and 501.

*Bully Boy Mine.* It comprises seven claims totaling 160 acres, located in Secs. 11 and 12, T. 30 S., R. 40 E., M. D. M., 12 miles south of Randsburg. Elevation 4150 feet. Owner, United Mines Inc.; C. R. Hannaman, president; M. J. McVan, secretary.

A series of parallel narrow quartz veins occur in the schist, strike N.  $65^{\circ}$  E., and dip  $50^{\circ}$  northeast. Widths are 6 to 12 inches. A number of shafts have been sunk on the different veins to depths of 50 to 100 feet. The main working shaft has been sunk on an incline of  $53^{\circ}$  to a depth of 100 feet, on the Bully Boy Vein. On the 50-foot level there is a drift west 150 feet and on the 100-foot level a drift west 50 feet.



Mine equipment consists of a 60-h.p. gas engine hoist, 10" x 10" Chicago pneumatic compressor, blacksmith shop and mine dwellings. The property is reported to have produced \$120,000. Idle.

Bibl: State Mineralogist's Report XIX, p. 171.

*Consolidated Mines.* It comprises 156 acres, patented, located in Sec. 35, T. 29 S., R. 40 E., M. D. M., one mile west of Johannesburg, in the Mojave Mining District. Elevation 3550 feet. Owner, Consolidated Mines Company. W. H. Herren, president, 710 I. W. Hellman Building, Los Angeles.

Two veins, the Good Hope and Butte, strike east and west, dip 56° south. Average width is 20 inches. Workings consist of shaft 300 feet deep with five levels and several thousand feet of drifts. Mine equipment consists of electric hoist. Mill equipment consists of 5-stamp mill. Idle.

Bibl: State Mineralogist's Report XIV, p. 496.

*Double Standard Mine.* It comprises 40 acres located in Sec. 5, T. 10 N., R. 12 W., S. B. M., in the Mojave Mining District, 3 miles south of Mojave. Elevation 2700 feet. Owner, Mojave Mining and Milling Company, 261 I. W. Hellman Building, Los Angeles. G. E. Denton, president; A. H. Walcott, secretary; E. B. Wagemann, superintendent.

The vein occurs in rhyolite porphyry. It strikes northeast, dips 40° west and has a width of 3 to 5 feet.

Workings consist of a shaft 200 feet deep, with levels at 100 and 200 feet. On the 100-foot level, the vein has been drifted on 650 feet; on the 200-foot level there are 850 feet of drifts. Mine equipment consists of hoist, cars and dwellings. Reduction equipment consists of 5-stamp mill. Idle.

Bibl: State Mineralogist's Reports XIX, p. 158; XIV, pp. 491-492.

*Dreadnot Mine (Blue Mountain).* It comprises 170 acres located in Secs. 11, 12 and 14, T. 25 S., R. 29 E., M. D. M., about 40 miles northwest of Bakersfield, in the Woody Mining District. Owners, Blue Mountain Mining Company; J. W. Howard, president; Rodney McCormick, secretary, Bakersfield, California.

Two parallel veins occur in the granite, strike east and west and dip 5° north. The veins have an average width of 2 feet. Workings consist of an incline shaft 450 feet deep, three levels and 4000 feet of drifts. Mine equipment consists of hoist and dwellings. Reduction equipment consists of 5-stamp mill. Production \$75,000. Idle.

Bibl: State Mineralogist's Reports XIV, p. 492; XII, p. 143.

*Echo and Gray Eagle Mines.* It comprises six claims totaling 120 acres, 60 acres of which is patented, located in Sec. 6, T. 10 N., R. 12 W., S. B. M., 4 miles south of Mojave, in the Mojave Mining District. Elevation 3500 feet. Owners, A. Asher and Bert Fisher, of Mojave, California.

There are three parallel veins on the property known as the Echo, Starlight and Gray Eagle which occur in rhyolite-porphyry. The general course of these veins is northwest and they dip to the northeast.

The outcrop of the Echo Vein can be traced on the surface for 180 feet and throughout its entire length it has a width of 4 feet. The gold occurs free associated with pyrite. The silver occurs as hornsilver (cerargyrite), changing to argentite in depth. The average value of the ore is reported to have been \$9 per ton, 60% of which was gold and 40% in silver. The ore shoots in the vein occur in irregular lenses which have a length of 100 to 200 feet. The Starlight vein is about 300 feet east of the Echo vein, is parallel to its strike and dips to the northeast. Average width is 3 feet. It is reported this vein carried a high silver content. The Gray Eagle vein commences near the northern end of the Starlight vein, diverging from it in a southerly direction but finally runs parallel to it. The dip is almost vertical and the average width about 3 feet.

Underground workings: At an elevation of 3100 feet, No. 1 Echo tunnel is driven N. 25° W., 230 feet to the Starlight vein and the vein drifted on 980 feet to the southeast. At 175 feet above this tunnel there is a drift run on the Gray Eagle vein 900 feet to the point where it came in contact with the Starlight vein. Gray Eagle tunnel is a crosscut southwest 180 feet to the Gypsy vein, with drift on this vein for 240 feet, then crosscut west 35 feet to Starlight vein, then drifted southeast 640 feet. Elevation of Gray Eagle tunnel is 3275 feet. Upper Starlight tunnel is driven 780 feet southeast on the Starlight vein. It is reported that a pay shoot 240 feet in length was developed on the Gray Eagle vein, the width being from 4 to 15 feet. These veins have been stoped to the surface above the tunnel levels. The property was formerly operated by the Echo Consolidated Mining Company, the ore being treated in a 10-stamp mill, which plant was dismantled in 1906. The mine is reported to have a production record of \$200,000 to \$400,000. Idle.

Bibl: State Mineralogist's Report XIX, pp. 158-159.

*Elephant Group of Mines.* It comprises approximately 100 acres located in Sec. 6, T. 10 N., R. 12 W., S. B. M., about 5 miles south of Mojave. Elevation 3000 feet. Owner, Nancy Dare Mining Company. R. Pierce, secretary, Oxnard, California.

Three roughly parallel veins, known as Hope, Excelsior and Elephant, have been developed on the property. These veins have a general northwest strike, with dips varying from 50 to 80° to the northeast. The veins occur in silicified rhyolite-porphyry. The vein material is highly brecciated, containing quartz and including silicified porphyry which is stained with iron oxide. The veins vary in width from 3 to 7 feet.

Workings on Elephant vein consist of a shaft 300 feet deep, sunk on an incline of 70°, with levels at 100, 200 and 300 feet. The Excelsior vein is developed by a shaft of 150 feet, sunk on the vein, which has a dip of 55°. The vein strikes N. 20° W. and has an average width of 3 feet. The vein has been drifted on the 50 and 150-foot levels for a distance of several hundred feet, and stoped to the surface. The Hope vein, which has a strike of N. 20° W., dips 70° east. Average width is 2 feet. This vein has been developed by a tunnel, a distance of 400 feet. Ore is trammed from Hope and Excelsior workings over a tram line 2500 feet in length to the mill below Elephant shaft.



Mine equipment: At Elephant shaft, equipment consists of 25-h.p. single-drum electric hoist, 300-cu. ft. Chicago pneumatic compressor, driven by 100-h.p. motor and transformers. Electric power is secured from the Southern California Edison Company.

Mill equipment: Ore from 100-ton storage bin goes to 8" x 12" Denver crusher, the  $\frac{3}{4}$ " product being elevated to storage bin in the mill. Ore from bins goes to one Denver quartz mill. The through size from Denver mill goes to 4' x 6' ball mill in closed circuit, with corr simplex classifier. The through size material passes over amalgamation plates. The pulp from amalgamation plates goes to one 2-cell Kraut flotation machine, the concentrate from the Kraut machine goes to one K & K flotation machine. The tails from the Kraut machine are retreated on a Wilfley table. This mill did not prove satisfactory in the treatment of the ore and operations were suspended the latter part of 1927. Idle.

Bibl: State Mineralogist's Report XIX, p. 159.

*Ella Group of Claims.* This group comprises 40 acres located in Amalie Mining District, in Sec. 29, T. 30 S., R. 33 E., M. D. M., 15 miles northeast of Caliente. Owner, Rainey Brothers, of Lorraine, California. Idle.

*Ellston Mine.* It is located in the Clear Creek Mining District, in Sec. 8, T. 29 S., R. 31 E., M. D. M., 20 miles north of Caliente. Owner, R. E. Ellston, of Caliente, California.

*Esperanza and Joe Morina Mines.* It comprises 10 claims located 20 miles northeast of Cinco, on the east slope of the Piute Mountains. Owner, Mrs. A. L. Gaulett, Mojave, California.

Development consists of a tunnel driven on the vein 350 feet. The vein has an average width of 2 feet, said to carry \$12 per ton in gold. One man employed.

*Exposed Treasure and Desert Queen Mines.* The largest producer in the Mojave Mining District comprises 280 acres of patented ground and 60 acres held by location, located in Sec. 32, T. 11 N., R. 12 W., S. B. M., about  $3\frac{1}{2}$  miles south of Mojave, on Bowers Hill. Owner, Standard Mining and Milling Company, Grosse Building, Los Angeles. W. E. Goodyear, president; James Westerfelt, secretary; W. H. Thorpe, manager. The property was acquired by the present company in 1921 from the Mojave Consolidated Gold Mines Company, who operated it until 1915.

Seven parallel veins have been developed on the property, of which the most productive have been the Exposed Treasure, Desert Queen and Yellow Rover. The principal development work has been confined to the Exposed Treasure and Desert Queen veins. These veins have a general north and south strike, but split in numerous branches which strike N. 30° W. The veins near the surface have a dip of 60° for a certain distance, then flatten to inclinations varying from 30 to 35°, growing flatter with depth, as the Exposed Treasure Vein on the 900-foot level has a dip of only 25° to the northeast. The veins have widths varying from 4 to 15 feet.

Workings consist of shafts on the different veins. On the Exposed Treasure Vein an incline shaft has been sunk to a depth of 900 feet



with levels at intervals of 100 feet, with over 10,000 feet of drifts and stopes. On the Desert Queen Vein a shaft has been sunk to a depth of 400 feet on a 70° incline, with levels at 100, 200, 300 and 380 feet. The vein has an average width of 3 feet, with a granite footwall and rhyolite-porphyry hanging wall. The most recent development has been a crosscut from 380-foot level of the Desert Queen shaft, intersecting the Exposed Treasure Vein 900 feet west of the Desert Queen shaft and at a depth of about 135 feet below the 900-foot level of the Exposed Treasure shaft. A very heavy flow of water was encountered in this crosscut. Due to the cost of handling this flow of water and also to a disastrous fire which destroyed the mill and surface plant, operations were suspended in the latter part of 1928.

Mine equipment consists of 30-h.p. electric hoist, Ingersoll Rand compressor, air drills, five Byron-Jackson pumps driven by electric motors, located at Desert Queen shaft. Electric power is secured from the Southern California Edison Company. Water is secured from the Tehachapi Mountains, a distance of 18 miles, through the Soledad pipeline, which is owned by the company. The production record to date is over \$2,000,000. Idle.

Bibl: State Mineralogist's Reports XIX, pp. 160-161; XIV, pp. 504-505; Transactions Am. Inst. Min. Engineers Vol. XXXVIII, pp. 310-319.

Bibl: State Mineralogist's Report XIV, p. 493.

*Gem Mine.* It comprises 8 claims situated on the ridge south of Kern River, 28 miles southeast of Bakersfield, in the Democrat Mining District. Elevation 2800 feet. Owner, John Wilson Estate, of San Francisco, California. Under option to Carl Haney; Quay Griggs and associates, of Bakersfield.

The formation is granite. The vein varies from 12 inches to 4 feet in width. The strike is northeast and southwest, with dip 45° southeast.

Workings consist of a crosscut tunnel driven S. 20° E. 650 feet to the vein, with a drift northeast 60 feet and southwest 200 feet on the vein. At 550 from the portal of the tunnel, a raise has been put up on an incline of 45° in the footwall, a distance of 90 feet to intersect the vein. At this elevation above main crosscut tunnel, a drift has been driven on the vein 110 feet to the northeast, and at 75 feet from the raise, encountered a shoot of ore. The vein has an average width of 4 feet and is said to carry from \$8 to \$20 per ton in gold for a distance of 45 feet. About 200 feet in elevation above the lower crosscut tunnel, there is another tunnel driven south 100 feet to the vein, with stopes to the surface. The total production is reported to have been \$30,000.

The property is equipped with one drill, Sullivan compressor, cars, blacksmith shop and 5-stamp mill. Three men employed.

*Glen Olive Mine.* It is situated in the Pioneer Mining District and comprises 120 acres in Sec. 33, T. 27 S., R. 33 E., M.D.M., 42 miles north of Caliente. Elevation 7500 feet. Owners, A. W. Stetson and associates, San Francisco.

Two parallel veins about 200 feet apart; average width 3 feet; strike northwest and southeast. Workings consist of two tunnels on the vein 200 feet apart, each tunnel being 700 feet in length. Production to date is \$500,000. Idle.

Bibl: State Mineralogist's Report XIV, p. 494.

*Gold Coin Mine.* It comprises four claims located in Secs. 31 and 32, 11 N., R. 12 W., S.B.M., 3 miles south of Mojave. Owners, New Tonopah Dividend Mining Company, Tonopah, Nevada. J. R. Cunningham, president; E. P. Cullinan, secretary and manager. The property is located west of the Yellow Dog Mine on the flat, at an elevation 2700 feet. A shaft was sunk to a depth of 200 feet. Idle.

Bibl: State Mineralogist's Report XIX, p. 162.

*Gold Crown Group.* It comprises 46 acres, patented, located in Secs. 1 and 12, T. 30 S., R. 40 E., M.D.M.  $2\frac{1}{2}$  miles south of Johannesburg, the Stringer Mining District. Elevation 4000 feet. Idle.

Bibl: State Mineralogist's Report XIV, p. 494.

*Golden Group, (Jack Rabbit).* It comprises 100 acres, located in Sec. 34, T. 30 S., R. 32 E., M.D.M., in Amalie District, 8 miles east of Caliente. Elevation 2000 feet. Owner, J. B. Ferris Estate, of Caliente, California.

The vein is 20 feet in width, strikes northwest and dips  $45^{\circ}$  north. Formation is granite.

Development consists of shaft 200 feet deep with three levels. Idle.

Bibl: State Mineralogist's Report XIV, p. 495.

*Gold Peak,* formerly known as the *Zada*, is situated in the Amalie Mining District, in Sec. 28, T. 30 S., R. 33 E., M.D.M., 14 miles northeast of Caliente.

Holdings consist of 340 acres, patented. Owner, Gold Peak Mining Company, of San Francisco, California. Production \$100,000. Idle.

Bibl: State Mineralogist's Report XIV, pp. 495-496.

*Good Luck Mine.* It comprises 40 acres located in Sec. 16, T. 27 S., R. 20 E., M.D.M., in the Long Tom Mining District, about 20 miles north of Bakersfield. Idle.

Bibl: State Mineralogist's Report XIV, pp. 496-497.

*Gold King Group of Mines.* It comprises 9 claims, located south of the Kern River, 28 miles southeast of Bakersfield, in the Democrat Mining District. Elevation 2400 feet. Owners, Chas. Ball and Associates, of Alhambra, California. Idle.

*Great Unknown Group of Claims.* These claims are situated in the San Antonio Mining District, 8 miles west of Cinco. This group comprises seven claims, totaling 140 acres. Owner, Mrs. J. S. Bishop of Cantil, California.

A quartz-porphyry dike about 100 feet in width occurs in granite. The dike is iron-stained and strikes N.  $10^{\circ}$  W. At intervals along this dike there are outcrops of quartz that vary from 2 to 6 feet in width. On the Badger Claim a shaft has been sunk to a depth of 80 feet in the dike and at the bottom of the shaft a crosscut has been driven east and west. It is reported samples taken from these workings carried from \$4 to \$6 in gold per ton. Idle.

*Grubstake Hill Placer Mine.* (Placer.) It comprises two placer claims located in Last Chance Canyon, 10 miles north of Cantil. Owner, Chas. Keohn, Gypsite, California.



The Grubstake Hill channel runs north and south. The channel has a width of 150 feet. The average thickness of the gravel is about 3 feet. The bedrock is clay. The gravel contains boulders of granite, quartzite and basalt, partially cemented with 'caliche' and clay. The pay gravel worked was from bedrock to a height of 3 feet. The gravel worked is reported to carry from 30 cents to \$2 per cu. yd.

Workings consist of a series of tunnels and the channel has been worked out for a distance of 1000 feet, to a height of 4 feet and width 40 to 100 feet. The gold recovered is very fine and light. Water for washing gravel was pumped from a well sunk to a depth of 60 feet in Last Chance Canyon. The property was operated during the early part of 1928 by W. O. Tuggle, of Cantil, California.

*Gwynne Mine.* (Formerly operated as the *Kern County Consolidated Gold Mines.*) It is situated in the Green Mountain District, in Sec. 22, T. 29 S., R. 34 E., M.D.M., about 25 miles northeast of Caliente. Holdings comprise 40 acres patented. Elevation 7500 feet. Owners Otto and Jack Geringer, Piute, California.

Two veins which have an average width of 12 to 18 inches strike northwest and southeast, dip 40° S. Workings consist of a shaft 300 feet deep and a tunnel 1500 feet in length. They are also driving a new tunnel to cut the other vein and are reported to have advanced 800 feet. Four men are employed.

*Haeger Mine.* It comprises two patented claims located in T. 9 N., R. 13 W., S.B.M., 5 miles northwest of Rosamond, a station on the Southern Pacific Railroad. Elevation 2500 feet. Owner, Mrs. Haeger, Los Angeles.

The vein occurs in rhyolite, strikes east and west, dips 60° south. Average width of vein is 4 feet.

Development consists of a shaft 200 feet deep sunk on the vein. Idle.

*Iconoclast Mine.* It is situated in Sec. 25, T. 27 S., R. 33 E., M. D. M., about 36 miles north of Caliente. Holdings consist of 3 claims. Elevation 8000 feet. Owner, R. E. Porter.

The vein is 2 feet wide, with granite footwall and slate hanging wall. Tunnel on vein 300 feet in length. Idle.

Bibl: State Mineralogist's Reports XIV, p. 497; XIII, p. 186.

*Illinois and Golden Bell Mines.* This group is situated in the Pioneer Mining District, in Sec. 16, T. 27 S., R. 33 E., M. D. M., 40 miles north of Caliente. Elevation 7800 feet. Owner, J. Peep, of Bodfish.

Holdings comprise 3 claims. The vein is 12 inches wide, with slate footwall and granite hanging wall. Development consists of a tunnel 300 feet in length on the vein. Idle.

Bibl: State Mineralogist's Report XIV, p. 497.

*Indian Queen Mine.* It comprises two claims located in Sec. 15, T. 27 S., R. 29 E., M. D. M., in the Long Tom Mining District, 22 miles northeast of Bakersfield. Owner, R. E. Dosworth, of Tulare, California. Idle.

Bibl: State Mineralogist's Report XIV, p. 497.

*Jeff Davis Mine.* (See North Sumner Mine.) It is situated in the



ove Mining District, in Sec. 28, T. 25 S., R. 33 E., M.D.M., about one-half mile north of Kernville.

Bibl: State Mineralogist's Reports XX, pp. 35-41; XIV, p. 498.

*Jennette Mine.* It is situated in the Green Mountain Mining District, in Sec. 22, T. 29 S., R. 34 E., M. D. M., 25 miles northeast of Saliente. Elevation 8000 feet. Holdings comprise 40 acres. Owner, Lombard, of Piute, California.

The vein occurs in granite, strike, northwest and southeast and dip  $9^{\circ}$ . Average width is 6 inches.

Development consists of a number of tunnels driven on the vein from 50 to 400 feet in length. Equipment consists of 4-stamp mill.

Bibl: State Mineralogist's Report XIV, p. 498.

*Josephine Mine.* It comprises 150 acres of patented claims situated in the Woody Mining District, in Secs. 2, 3, 4, 5 and 8, T. 25 S., R. 29 E., M. D. M., about 5 miles southeast of White River, P. O. Elevation 4000 feet. Owner, W. Adams, of Corinth, Miss.

Six parallel veins occur in quartz-porphyry and slate, strike east and west and dip  $45^{\circ}$  east.

Development consists of a tunnel 300 feet long and several thousand feet of drifts and crosscuts. Idle.

Bibl: State Mineralogist's Reports XIV, p. 498; XIII, p. 191; XII, p. 145.

*Karma Mine.* It comprises the following claims: Karma, Ajax, Attention Junction, totaling 70 acres, located in Sec. 6, T. 10 N., R. 12 W., S. B. M., about 4 miles south of Mojave. Elevation 3200 feet. Owner, E. L. Wegmann, of Mojave, California.

Two parallel veins have been developed on the property. The outcrops of these veins can be traced on the surface for 1000 feet. The veins vary in width from 4 to 15 feet. The general course of the veins is N.  $10^{\circ}$  W., dip  $60^{\circ}$  east, with silicified rhyolite-porphyry walls.

Development consists of a tunnel driven south 1800 feet on the Karma vein. About 100 feet in elevation above the portal of the tunnel, there is a glory hole stope 200 feet in length and about 50 feet in width. On the same level as the tunnel, a shaft has been sunk to a depth of 160 feet. The pay shoot developed in the tunnel is said to be 240 feet in length and it has a width of 15 feet. A high grade streak of ore occurs on the hanging wall of the vein.

Mine equipment consists of cars, assay office, shops and dwellings. Reduction equipment consists of 20 stamps, weight 850 pounds each. Idle.

Bibl: State Mineralogist's Reports XIV, p. 499; XIX, p. 161.

*Keyes Mine.* It comprises 8 claims totaling 160 acres, situated in Sec. 26, T. 26 S., R. 32 E., M. D. M., in Keyes Mining District, 3 miles southeast of Isabella. Elevation 3600 feet. Owner, *Kern River Mining Company*; A. A. Cash, secretary. Office address: 2240 San Fernando Road, Los Angeles. Under lease and bond to the *National Engineering Company*; Chas. C. Randall, president; J. E. Fisher, secretary, Anaheim, California. Herbert Lee, superintendent.

Two parallel veins occur in the granite, known as the Keyes and Matilda veins. The principal development has been on the Key Vein. The Keyes Vein is from 12 inches to 2 feet wide, strike north east and southwest and dip  $70^{\circ}$  east. The vein quartz is free-mill and high grade.

Developments consist of a crosscut tunnel driven west 840 feet to the Keyes Vein, with drift southwest on the vein for a distance of 14 feet. At 800 feet southwest of the crosscut tunnel, a winze has been sunk to a depth of 40 feet. The vein at this point was 30 inches wide and said to have an average value of \$100 per ton. The crosscut tunnel intersected the Matilda Vein at 590 feet from the portal of the tunnel. It is planned to drift to the southwest on this vein in hope of developing the ore shoot that was worked near the surface. The depth of the workings below the surface outcrop is about 450 feet. The Keyes Vein has been stoped from tunnel level to surface.

Mine equipment consists of a Chicago pneumatic compressor, capable of operating 4 drills. Mill equipment consists of 5 stamps, 110 pounds; Forester-Rexman rod mill; amalgamation plates; one Wilfley concentrator and one Cottrell concentrator. Mill is driven by a 20 h.p. Western gas engine. On the mill run of 100 tons of ore from the Keyes Vein, a recovery of \$84 per ton in gold on the plates was made. Six men are employed. Producer.

Bibl: State Mineralogist's Reports XIV, p. 499; XIII, p. 191; XII, p. 145; U. S. G. S., Mineral Resources of United States.

*King Solomon Mine.* It comprises 5 claims situated in Sec. 35, T. 29 S., R. 40 E., M. D. M., three-quarters of a mile west of Johannesburg in the Rand District. Elevation 3900 feet. Owner, King Solomon Consolidated Mines Company, of Los Angeles. E. Shipsey, president; J. Shipsey, superintendent. Under lease to J. P. Woods, of Johannesburg.

The property has been developed by a number of shafts, the main shaft being two compartments, sunk on the vein to a depth of 480 feet. There are seven levels, with over 10,000 feet of underground workings. A number of veins have been developed on the property. The King Solomon Vein strikes N.  $80^{\circ}$  W., dipping  $40^{\circ}$  N. It averages from 2 to 4 feet in width. The main vein strikes N.  $35^{\circ}$  W., dips  $45^{\circ}$  NE. Average width is 2 feet. A cross vein which strikes S.  $70^{\circ}$  E., and dips  $50^{\circ}$  N., intersects the main vein south of the shaft. These veins are in general brecciated and consist chiefly of mineralized and iron-stained schist with some vein quartz. The wall rocks are in places schist and in other places quartz-monzonite. The pay ore usually follows close to the hanging wall but the values occur in irregular bunches in the veins. The average value of the ore mined is said to carry \$2 per ton in gold. The total production of the property is reported to have been about \$500,000.

Mine equipment consists of electric-driven hoist and 3-drill compressor. Mill equipment consists of 5-stamp mill, with amalgamation plates. Six men are employed.

Bibl: State Mineralogist's Report XIV, p. 500; Bull. 95; "Geology and Ore Deposits of the Randsburg Quadrangle," pp. 136-137.

*La Cross Mine.* It comprises 20 acres situated in the Stringer District, in Sec. 2, T. 30 S., R. 40 E., about  $1\frac{1}{2}$  miles south of Randsburg, an elevation of 4000 feet. Owner, H. Putman, of Los Angeles.

A series of narrow parallel veins occur in schist. Average width is inches. High grade. Development consists of a number of shafts 0 to 100 feet in depth. Idle.

Bibl: State Mineralogist's Report XIV, p. 500.

*Lida Mine.* (See Tropico Mines.)

*Little Angel Mine.* It consists of 40 acres in Clear Creek District, in Sec. 2, T. 28 S., R. 32 E., M. D. M., about 30 miles north of Caliente. Owner, S. C. Smith, Havilah, California.

A narrow high grade vein of quartz occurs in the granite. Development consists of a tunnel 320 feet in length. Idle.

Bibl: State Mineralogist's Reports XIV, p. 501; XIII, p. 192.

*Little Bonanza Mine.* It is situated in the Green Mountain Mining District, in Sec. 25, T. 26 S., R. 32 E., M. D. M., about 5 miles south of Isabella. Elevation 4100 feet. Holdings comprise 20 acres. Owner, A. R. Lucy, Isabella, California.

A narrow quartz vein occurs in the granite. Development consists of a tunnel 140 feet in length driven on the vein. Idle.

Bibl: State Mineralogist's Reports XIV, p. 501; XII, p. 191.

*Little Butte Mine.* It comprises 60 acres in the Rand District, in Sec. 35, T. 29 S., R. 40 E., M. D. M., about one mile west of Johannesburg. Elevation 3000 feet. Owner, Little Butte Mining and Milling Company, of Los Angeles; C. W. Clark, president; Dr. J. W. Oakley, secretary.

Two parallel veins occur in the schist and strike northwest with a dip of  $45^{\circ}$  NE. These veins cut through rhyolite dikes. The ore mined from these veins is reported to be high grade and said to carry values from \$25 to \$600 per ton.

Development consists of a shaft sunk on an incline to a depth of 600 feet, with nine levels. Total amount of drifting and crosscutting amounts to several thousand feet. Sulphide ore is reported to have been encountered on the 600-foot level. It is said to carry values in gold and silver. The production of the property is estimated to have been \$400,000. The mine is equipped with electric hoist and 2-stamp mill, consisting of 950-pound stamps. Idle.

Bibl: State Mineralogist's Report XIV, p. 502; Bull. 95, p. 137.

*Long Tom Mine.* It comprises 6 patented claims totaling 120 acres, situated in the Long Tom Mining District, in Sec. 21, T. 37 S., R. 29 E., M. D. M., 20 miles northeast of Bakersfield. Elevation 1600 feet. Owner, Long Tom Mining Company, Bakersfield, California.

The vein has a width of 16 inches, strike northwest and southeast, dip  $45^{\circ}$  north. The footwall of the vein is diabase with a granite hanging wall.

Development consists of a shaft 380 feet deep sunk on the vein; several thousand feet of drifts. Equipment consists of dwellings, blacksmith shop, hoist and a 20-stamp mill. Idle.

Bibl: State Mineralogist's Reports XIV, p. 502; XI, p. 238.



*Mammoth Mine.* It comprises 12 claims, totaling 240 acres, situated in the Keys Mining District, in Sec. 35, T. 26 S., R. 32 E., M. D. M 5 miles south of Isabella. Elevation 3850 feet. Owner, *Mammoth Mountain Mining Company*; J. H. Copelin, president; G. W. Russell, secretary. Offices: Chamber of Commerce Building, Los Angeles.



Five-stamp Mill. Mammoth Mine. Keyesville, Kern County.



Portal of Main Tunnel. Mammoth Mine. Keyesville, Kern County.

The property was discovered in 1855, shortly after the discovery of the Keyes Mine and has been operated off and on for the past sixty years. The property is reported to have a production record of \$3,000,000. The Mammoth Vein is from 2 to 15 feet wide, average width being 3 feet. The vein strikes northeast and southwest, dips 70°

at, with 10,000 feet on the lode. The formation is granite, although the footwall the casing is made up of slate. The vein quartz is fine-milling, said to carry \$5 to \$25 per ton in gold. Two veins have been developed on the lower tunnel, known as Footwall and Hanging wall veins. The lower or main working tunnel is driven S. 40° W., 30 feet. At 800 feet from the portal, a winze has been sunk on the Footwall Vein to a depth of 200 feet. At 165 feet below the collar of the winze, a level has been driven on the vein 100 feet to the northeast, and 180 feet to the southwest. Near the location of the winze a raise has been put up 95 feet to No. 4 tunnel. Workings on the vein are as follows:

No. 6, Lower Tunnel-----	1580 ft.
No. 4 Tunnel 104 feet in elevation above No. 5-----	775 ft.
No. 3 Tunnel 119 feet in elevation above No. 5-----	735 ft.
No. 2 Tunnel 145 feet in elevation above No. 4-----	450 ft.
Total -----	3540 ft.

On No. 2 tunnel which is located on the southwest slope of the hill the McGill ore-shoot is stated to have been 280 feet long, with an average width of 4 feet. This shoot was stoped to the surface a distance of 150 feet. The ore mined is said to have carried values in gold running from \$20 to \$54 per ton.

Tunnel No. 3 developed the Tom Lane ore-shoot which is stated to have been 160 feet long, by 120 feet high and with an average width of 4 feet.

Tunnel No. 4 developed the Higgins ore-shoot, which was 500 feet long and 150 feet high, average width being 4 feet.

In the winze on tunnel No. 5 ore-shoot 120 feet long by 3 feet wide has been developed. The ore mined from the winze is reported to have averaged \$17 per ton. The production from this shoot of ore was 10,000.

Mine equipment consists of single-drum; 10-h.p. electric-driven hoist; mining triplex pump driven by 3-h.p. motor; 12" x 12" compressor driven by 50-h.p. motor; blacksmith shop and dwellings.

Mill equipment consists of 10-stamp mill, 1000-pound stamps; amalgamation plates. The mill is electrically driven. Electric power secured from the Southern California Edison Company.

Property was operated from 1913 to 1923. Idle.

Bibl: State Mineralogist's Reports XIV, p. 502; XIII, p. 193.

*McKidney Mine.* It comprises three claims, in Sec. 9, T. 28 S., R. 2 E., M. D. M., 28 miles north of Caliente, in the Clear Creek Mining district. Elevation 4300 feet. Owner, D. Fergusin, Havilah, California. Three parallel veins occur in the granite, strike northeast and southwest, dip 75° south. Average width is 2 feet. The main development has been on the McKidney vein. Workings consist of a shaft 230 feet deep, with two levels and over 1000 feet of drifts and stopes. Idle.

Bibl: State Mineralogist's Reports XIV, p. 503; XIII, p. 193.

*Minnehaha Mine.* It comprises 4 claims, situated in Sec. 2, T. 29 S., R. 40 E., M. D. M., 3 miles west of Randsburg. Elevation 3800 feet. Owner, Judge E. B. Maginnis, of Randsburg, California.



The vein occurs in the schist with some quartz monzonite and also cuts a rhyolite dike. The vein strikes N.  $35^{\circ}$  W. and dips  $45^{\circ}$  N. The vein is from 2 to 7 feet in width. The values in the vein are very erratic but the ore mined is high grade, showing values of \$100 per ton.

Workings consist of 4 tunnels, each over 400 feet long and four shafts about 100 feet deep. There are over 1000 feet of underground workings on the property, with the deepest development being about 300 feet. The property has been operated for years by leasers. It is estimated that the property has produced \$100,000. Three men employed.

Bibl: State Mineralogist's Report XIV, p. 503; Bull. 95, "Geology and Ore Deposits of the Randsburg Quadrangle."

*Nellie Dent and Content Mines.* (See Big Blue-Sumner Mines.)

Bibl: State Mineralogist's Reports XX, p. 41; XIV, p. 505; Raymond, U. S. Commissioner of Mineral Statistics, 1875.

*New Mex Group of Claims.* This group comprises 3 claims, situated 3 miles northwest of Gypsite, a siding on the Southern Pacific Railroad on the east slope of the El Paso Range of mountains. Elevation 2400 feet. Owner, Mrs. J. S. Bishop, Cantil, California.

The vein strikes N.  $45^{\circ}$  W. and dips  $70^{\circ}$  SW. Width is 3 feet. Formation granite. The vein quartz is mineralized with galena, chalcopryrite, pyrite and carries values in gold and silver.

Developments consist of a shaft 60 feet deep and a tunnel 40 feet in length, both on the vein. Idle.

*North Sumner Gold Mines, Inc.* P. V. Long, president; M. S. Baylor, secretary; R. L. Long, general manager. Office, 203 Merchant Exchange Building, San Francisco. The company has a lease and bond on the following mines in the Cove Mining District: Beauregard, North Extension Sumner, Frank, Urbana, Red Hill, Stirrup, and Zade, consisting of 115 acres, located in Sec. 28, T. 25 S., R. 33 E., M. D. M. three-quarters of a mile north of Kernville. Elevation 2860 feet.

There are five veins in the hanging wall granite, known as the Beauregard, Urbana, Frank, Lady Belle-Bull Run and Jeff Davis, which form a junction with the main fissure (Big Blue-Sumner Lode) on the Sumner North Extension Claim. The Beauregard Vein strikes N.  $75^{\circ}$  E., dips  $85^{\circ}$  NW., and has an average width of 4 feet. The pay shoot worked is said to be 600 feet in length with an average width of 3 feet. The ore is free-milling and plates \$20 to \$35 per ton. Concentrates are said to average \$150 per ton.

Workings consist of seven shafts from 100 to 300 feet deep, three levels, 2500 feet of drifts and six stopes. The Beauregard shaft is 300 feet deep, with levels at 100', 200' and 300'. On the 200-foot level the vein has been drifted on 650 feet to the northeast to a point where the main north and south fault cut the vein off, and this fault was drifted on 200 feet to the north. A crosscut has been driven from this level 200 feet east into the slate footwall, intersecting the Big Blue-Sumner Vein. The Urbana Vein strikes N.  $50^{\circ}$  E., dips  $75^{\circ}$  NW., and has an average width of 18 inches. Pay shoot is reported to have been 600 feet long. Workings consist of five shafts 50 to 180 feet deep, with drifts and stopes. The Frank Vein strikes N.  $40^{\circ}$  E., and dips  $77^{\circ}$  NW.



The vein forms a junction with the Urbana Vein about 200 feet northeast of the Beauregard shaft and also merges with the Beauregard Vein on dip and strike to the northeast.

Mine equipment consists of single-drum hoist; 650-cu.ft. Ingersoll-Sargent compressor driven by water turbines; air drills; 2 Cameron pumps; assay office; ore bins and cars.

Mill equipment consists of 10-stamp mill, with 850-pound stamps. Idle.

Bibl: State Mineralogist's Reports XX, pp. 36-40; XIV, pp. 487-488.

*Norden Placer Mine.* (Dry Placer.) It comprises 9 placer claims totaling over 120 acres, located in Sec. 22, T. 29 S., R. 40 E., M. D. M., 2 miles north of Randsburg. Elevation 2500 feet. Owner, *Cresta Escorvada Corporation*; Mr. Norden, president, Los Angeles.

The auriferous gravels occur in the alluvium to the north and adjacent to the Rand Mountains. Sixteen shafts have been sunk on these claims to depths varying from 16 to 30 feet. The gravel is 12 feet in thickness with 4 to 16 feet of overburden. The gravels are unassorted, containing many large boulders. They are closely packed and cemented with 'caliche.' The bed rock is schist. The gold occurs evenly distributed throughout the gravels. The average value of the gravel is reported to vary from 80 cents to \$2 per cubic yard. The gold recovered is valued at \$18 per ounce. Several attempts have been made to work these gravels by dry concentration methods, and also by suction dredge with water secured from the Yellow Aster Mining Company's pipe line, but with poor success.

Bibl: Bull. 95, pp. 145-147.

*Old Cowboy Mine.* It comprises 80 acres in Sec. 28, T. 30 S., R. 33 E., M. D. M., in Amalie District, 14 miles northeast of Caliente. Elevation 2800 feet. Owner, A. E. Bryson, Los Angeles.

The vein occurs in quartz-porphyry, with a strike northeast and southwest and dip south 40°. The vein has an average width of 12 feet. The ore shoot developed is said to have been 230 feet long with an average width of 12 feet.

Development consists of a tunnel on the vein 500 feet in length with several hundred feet of drifts and stopes. The estimated production is over \$100,000. Idle.

Bibl: State Mineralogist's Report XIV, p. 505.

*Operator Divide Mine* (Phoenix). It comprises 7 claims located in Sec. 35, T. 29 S., R. 40 E., M. D. M., one-half mile north of Johannesburg. Owner, Operator Divide Mining Company, Randsburg, California.

Five veins have been developed on the property, strike northwest and southeast, with a dip of 20° northeast. They vary in width from a few inches to 7 feet, the average width being about 2 feet. The formation is schist, although in places rhyolite and diabase dikes occur as the walls of the veins. The ore is oxidized and free-milling. Values vary from a few dollars to \$25 per ton.

The principal development is confined to the Phoenix Vein on the old Phoenix Mine, which was developed by an incline shaft to a depth of

300 feet, with six levels and about 2000 feet of drifts. The property is equipped with a 10-stamp mill. The Phoenix Mine has a record of production of over \$600,000. It is reported that 35,000 tons of ore milled had an average value of \$17 per ton. Idle.

Bibl: State Mineralogist's Report XIV, p. 507; Bull. 95, p. 140.

*Ophir Mine.* It comprises 40 acres, patented, situated in Sec. 11 T. 28 S., R. 32 E., M. D. M., in Clear Creek District, 29 miles north of Caliente. Elevation 4200 feet. Owner, J. E. Waters, Havilah, California.

The vein is 4 feet wide with slate walls. Development consists of a tunnel on the vein 400 feet long and 600 feet of drifts. Idle.

Bibl: State Mineralogist's Reports XIV, p. 506; XIII, p. 194.

*Oro Fino Placer.* (See Summit Diggings.)

Bibl: Bull. 95, pp. 147-148, 'Geology and Ore Deposits of the Randsburg Quadrangle.'

*Orphan Girl Mine.* It comprises one claim of 20 acres located in the Stringer District, in Sec. 12, T. 29 S., R. 40 E., M. D. M., one and one-half miles south of Randsburg. Elevation 3800 feet. Owner, O. A. Phillips and D. C. Spearman, Randsburg, California.

A narrow vein occurs in the schist which strikes N. 50° W. and dips 30° NE. About 300 feet north of the shaft this vein intersects the Sunshine Vein which has an east and west strike and dips 80° south. These veins are from 8 inches to 12 inches in width.

Development consists of an incline shaft sunk on the Orphan Girl Vein to a depth of 370 feet. This vein has a dip of 35° to the 200-foot level, where the vein assumed a steeper inclination of 65°. Drifts have been run on the 100, 200 and 300-foot levels. The ore mined is hauled to the Windy mill north of Randsburg for treatment. One hundred tons of ore treated in this mill averaged \$11 per ton.

Equipment consists of 8½" x 10" Worthington compressor; 25-h.p. gas engine hoist; blacksmith shop; and buildings. Six men are employed.

*Pay Roll Mine.* It comprises 5 claims situated on the ridge south of Kern River, in the Democrat Mining District, 29 miles southeast of Bakersfield. Elevation 2200 feet. Owner, A. L. Connors, Bakersfield, California.

Two veins occur in the granite, one strikes northeast and southwest, the other east and west and dips 45° S. The veins are from 12 inches to 2 feet in width.

Developments consist of short tunnels and shallow shafts. Two men are employed.

*Pearl Wedge Mine.* It comprises one claim situated in the Stringer District, in Sec. 11, T. 29 S., R. 40 E., M. D. M., 1½ miles south of Randsburg. Owner, Mrs. Grace Jewett, Los Angeles.

A narrow vein occurs in the schist with a strike of northeast and southwest and dip 40° to the northwest. The vein is 8 inches to 2 feet in width. Three shafts have been sunk on the vein to depths of 150 feet. Idle.



*Pennsylvania Mine.* It comprises two claims, Pennsylvania and Early Sunrise, situated in the Keyesville Mining District, 5 miles south of Isabella. Elevation 3350 feet. Owners, James Walker and Marshall Brothers, of Keyesville, California.

These claims adjoin the Mammoth group of mines on the west. The vein strikes northeast and dips  $70^{\circ}$  E. The wall rocks are granite. The vein is 6 inches to 2 feet in width.

Development consists of shaft 200 feet deep and tunnels. Twenty tons of ore extracted is reported to have milled \$150 per ton. Idle.

*Pine Tree Mine* (American). It comprises 170 acres, patented, in Secs. 3 and 4, T. 11 N., R. 15 W., S. B. M., about 6 miles south of Tehachapi. Elevation 5000 feet. Owner, Geo. Gordon.

Two parallel veins occur in the granite with a northeast strike and dip  $45^{\circ}$  E. Average width of veins is 4 feet.

Workings consist of several tunnels on the Pine Tree Vein. The longest tunnel is said to be 800 feet, with several thousand feet of drifts and stopes. The ore was treated in a Huntington mill. Workings are abandoned. Production is reported to have been about \$250,000. Idle.

Bibl: State Mineralogist's Reports XIV, p. 506; XIII, p. 194.

*Piute Consolidated Mines.* It comprises 100 acres, in the Valley View District, in Sec. 13, T. 28 S., R. 34 E., M. D. M., 42 miles north of Caliente. Elevation 7500 feet.

The vein is 2 feet wide, strikes northeast and southwest and dips  $45^{\circ}$  south; granite footwall and quartz-porphphy hanging wall. Developed by crosscut tunnel 300 feet in length. Idle.

Bibl: State Mineralogist's Report XIV, pp. 506-507.

*Poso Mine.* It comprises 13 claims located in the Pine Mountain District, in Secs. 30 and 31, T. 27 S., R. 20 E., M. D. M., 22 miles northeast of Bakersfield, on Poso Creek. Owners, Poso Mining and Milling Company, Bakersfield, California; E. W. McCutchen, president; J. A. Lewis, secretary.

Three parallel veins occur in the granite, striking N.  $45^{\circ}$  W., and dipping  $65^{\circ}$  SW. Width of veins is 2 to 4 feet. The ore is free-milling gold quartz with some hematite and pyrite. It also carries values in silver.

Development consists of a shaft sunk on one of the veins to a depth of 120 feet, on an incline of  $70^{\circ}$ . From Poso Creek, a tunnel driven on this vein 365 feet to the northwest, connects with the shaft at a depth of 120 feet. The vein developed in this tunnel shows from 18 inches to 4 feet of oxidized quartz, mineralized with hematite and some iron pyrite. An ore shoot was developed 210 feet from the portal of the tunnel which was said to average from \$10 to \$12 in gold per ton, with some silver values. The length of the pay shoot is 150 feet, with an average width of 2 feet. About twenty feet southeast of the shaft the vein is cut by a fault that strikes N.  $75^{\circ}$  E., dipping  $40^{\circ}$  SE. This fault also cuts the ore shoot.

Mine equipment: Compressor and air drills; 16-h.p. gas engine hoist. Mill equipment: Blake crusher; 5-foot Huntington mill; Wilfley concentrator driven by  $37\frac{1}{2}$ -h.p. Fairbanks-Morse, type Y, Semi-Diesel vertical engine. Idle.



*President Mine* consists of 20 acres in Sec. 4, T. 27 S., R. 32 E. M. D. M., in the Keys District, about 5 miles south of Isabella.

Bibl: State Mineralogist's Report XIV, pp. 507-508.

*Queen Esther Mine.* It comprises 160 acres located in Sec. 6, T. 14 N., R. 12 W., S. B. M., 4 miles south of Mojave. Elevation 3200 feet. Owner, Queen Esther Mining and Milling Company, Los Angeles.

The Queen Esther Vein runs nearly north and south. It dips 40° to the east. The vein has a width of 4 to 8 feet and at places attains a maximum width of 12 feet. The country rock is a silicified rhyolite porphyry.

Underground workings consist of several tunnels on the vein 500 feet in length, with several thousand feet of drifts. Some of the ore contained considerable silver. Idle.

Bibl: State Mineralogist's Report XIV, p. 508.

*Red Hill Mine.* (See North Sumner Gold Mines.) It is situated in Cove Mining District, in Sec. 21, T. 25 S., R. 33 E., M. D. M., one-half mile north of Kernville. Elevation 3500 feet.

Bibl: State Mineralogist's Report XIV, p. 509.

*Ricardo Placer Mines.* It comprises 3000 acres of patented placer claims, known as: Ricardo, Deep Channel, Ricardo Deep Channel No. 1 and Tufa Quarry, situated on both sides of Iron Canyon, a tributary to Red Rock Canyon, in Sec. 2, T. 30 S., R. 37 E. and Sec. 35, T. 29 S., R. 37 E., S. B. M., 20 miles north of Mojave. Elevation 2300 feet. Owner, Rudolph Hagen, Ricardo, California.

The placer deposits in this area extend along the line of hills on both sides of Iron Canyon for a distance of several miles. The formation consists of a series of beds of conglomerate sandstone and lava flows. The conglomerates at the base of these hills are free from volcanic pebbles, but consist of many kinds of rock some of which are foreign to the district. The richest gulch worked during 1894 and 1896 was known as Bonanza, which lies 2 miles east of Ricardo. Here the gold was found in the wash from the basal conglomerates and lava tuffs. It was found not only in the gulches but on the slopes of the hills above the gulches. These placer diggings were formerly worked by the use of dry washers. During recent years considerable money has been spent in attempts to sink to bedrock through the wash of Iron Canyon but these operations did not prove successful on account of the heavy flow of water encountered. Idle.

Bibl: State Mineralogist's Reports XIII, p. 195; XII, pp. 456-458.

*Riches and Wealth Group of Claims.* This group comprises 7 lode claims and 8 placer claims, in the Keys Mining District, in the NW¼ of Sec. 19, T. 26 S., R. 33 E., M. D. M., 2 miles west of Isabella. Owner, Earnest Griffith, Bakersfield, California.

Two parallel veins occur in the granite, strike northeast and southwest and dip 45° NW., widths being from 8 to 12 inches.

Development consists of a shaft 60 feet deep and a tunnel 200 feet in length. The placer claims are located on French Gulch. Workings consist of two tunnels driven on bedrock. The gravel is loose and contains large boulders of quartz and granite. The gravel from these

workings and the gulch goes to  $\frac{1}{4}$ -inch screen and from screen to sluice boxes. Water for sluicing operations is secured from creek. A recovery of \$50 was made from 30 cubic yards of gravel. The gold is fairly coarse. Two men are employed.

*Rustler and San Diego Mines.* It comprises two claims adjoining the Yellow Aster Mine on the west, situated in Sec. 2, T. 29 S., R. 40 E., M. D. M., one mile west of Randsburg, in the Rand Mining District. Owners, E. B. McGinnis and J. T. O'Leary, of Randsburg, California. Stringer lead in schist and rhyolite. Idle.

Bibl: State Mineralogist's Report XIV, p. 509.

*San Antonio Mine.* It comprises 4 claims located 10 miles west of Arco, in the San Antonio Mining District. Elevation 3850 feet. Owner, E. S. Emmons, Bakersfield, California.

A series of narrow parallel veins occur in the granite. These veins strike east and dip  $70^{\circ}$  N. Widths vary from 12 inches to 2 feet. Development consists of 4 shafts sunk on different veins with depths varying from 50 to 150 feet. Idle.

*Sailor Boy Mine.* (Silver Bow.) It comprises 4 claims located on the northeast slope of Soledad Mountain, in the Mojave Mining District, 4 miles south of Mojave. Elevation 3000 feet. Owners, Gus Olberg and C. C. Moore, Mojave, California.

The vein is from 2 to 3 feet wide and occurs in rhyolite. The vein strikes N.  $20^{\circ}$  W. and dips  $60^{\circ}$  E. A crosscut tunnel has been driven 100 feet to the vein, with a drift south 200 feet on the vein, also a drift north for a distance of 50 feet. Near the point where the vein crosses, a shoot of ore 40 feet in length was developed. The ore was stoped to the surface for a distance of 75 feet. It is stated that the ore extracted had an average value of \$20 per ton in gold and \$10 per ton in silver. Also at this point, a winze was sunk to a depth of 10 feet. Two hundred tons of ore were shipped to the smelter from these workings that gave an average of \$20 per ton in gold. Idle.

Bibl: State Mineralogist's Report XIV, p. 510.

*Southern Cross Mine,* consists of 240 acres, Secs. 3 and 10, T. 28 S., R. 32 E., M. D. M., in the Clear Creek Mining District, about 20 miles north of Caliente. Elevation 4200 feet. Owner, A. Neelson, Havilah, California.

The vein is 20 feet wide, strikes northeast and dips  $50^{\circ}$  S., in granite. Workings consist of a tunnel driven on the vein 360 feet and about 100 feet of drifts. Idle.

Bibl: State Mineralogist's Report XIV, p. 510.

*Stanford Group* consists of the Orphan Boy, Gold Coin and Stanford claims, situated in Sec. 12, T. 30 S., R. 40 E., M. D. M., in the Rand District,  $1\frac{1}{2}$  miles south of Randsburg. There is a narrow vein in schist. Workings consist of a shaft 400 feet deep, with several thousand feet of drifts and stopes. Idle.

Bibl: State Mineralogist's Report XIV, p. 510.

*St. John Mine.* It comprises 7 claims, situated in Sec. 33, T. 28 S., R. 35 E., M. D. M., 20 miles southeast of Weldon and 3 miles south of



Tunnel Springs on the Kelso Valley road. Elevation 5400 feet. Owner, J. H. Copelin, of Los Angeles and Andrew Miller, of Weldon, California.

This property was worked in the early seventies by Senator Jones and Senator Stewart, of Nevada. Operations were suspended about the time the Big Blue Mine was discovered in the Cove Mining District. Originally there were two mills located near Tunnel Springs. The tailings from these mills were cyanided and it is stated that \$7 to \$15 per ton in gold was recovered.

Two veins occur in granite, strike N. 50° W. and dip 45° SW. The main vein has an average width of 4 feet. In the footwall of this vein there is a narrow vein about 6 to 8 inches wide which is said to have produced some very high grade ore.

Development consists of a shaft 600 feet deep sunk on the vein. About 200 feet southeast of this shaft there is another shaft 150 feet



Gold placer plant at Summit Diggings. Western Placer Mines Company.  
Summit Diggings, Kern County.

deep which connects with the old stoped area. To the southeast of these workings there are a number of shafts with depths varying from 50 to 100 feet. The vein southeast of the main working appears to be faulted about 150 feet to the northeast. It is stated that the ore shoot developed and stoped was 200 feet in length and had an average width of 2 feet. Idle.

*Summit Gold Placers.* It comprises a group of placer claims located at Summit Diggings, situated in Secs. 1 and 12, T. 29 S., R. 40 E., and in Sec. 6, T. 29 S., R. 41 E., M. D. M., 6 miles east of Goler and 6 miles north of Randsburg. Elevation 3300 feet. Owner, *Western Placer Mines Company*; J. S. Tremayne, president; J. R. Beering, secretary. Offices, Citizens Bank Building, Los Angeles.

The gravels being worked consist of reconcentrations of the older alluvium in recent watercourses. The gravels are unassorted and vary from 2 to 10 feet in thickness, containing many large boulders. The



values occur uniformly distributed throughout the gravel. The gold is fairly coarse. Samples from test holes sunk through the gravels on the holdings of the company are reported to carry from \$0.35 to \$1.00 per cubic yard. Water for working the gravels is secured from a well at Goler, through a 6" pipeline, six miles in length, with a lift of 80 feet.

The water is pumped by two Worthington pumps to a large supply tank at Summit Diggings, having a capacity of 80,000 gallons. A Bucyrus-Erie shovel,  $1\frac{1}{2}$ -yard dipper, loads the gravel into the hopper from which it is fed to a revolving screen, with  $\frac{3}{4}$ " round openings, with 8-mesh jacket screen. The oversize from trommel goes to tailings pile. The oversize from 8-mesh screen goes to tailings stacker. The minus 8-mesh goes by gravity through 8" pipeline to distributor, from which it flows over four tables, with Hungarian iron riffles. These tables are 14 feet long by 5 feet wide, divided into two compartments. The tables have a  $12^\circ$  slope. Tailings from tables are pumped by centrifugal pump to tailings pond. About 5000 cubic yards of gravel have been treated during a preliminary test run but the recovery of the gold has proved difficult due to the large amount of black sands found in the gravel. Ten men are employed.

*Sumner and North Extension Mines.* (See North Sumner Gold Mines.) These mines are situated in the Cove Mining District, about one mile north of Kernville. Elevation 3000 feet.

Bibl: State Mineralogist's Reports XX, pp. 35-40; XIV, pp. 487-488; VIII, p. 315; U. S. Commissioner of Mining Statistics, Seventh Report.

*Sunset Placer Mine.* (Placer.) It comprises 40 acres located on the north bank of the Kern River, 29 miles southeast of Bakersfield. Benches of gravel which have been worked in the past by ground sluicing occur on the north bank of the river in this area. Considerable gold is stated to have been recovered from these gravels. The gravel is 4 to 8 feet thick, the bedrock being granite. Idle.

*Sunshine Mine.* It consists of 18 acres, patented, in Sec. 11, T. 30 S., R. 40 E., M. D. M., in the Stringer District,  $1\frac{1}{2}$  miles south of Randsburg. Elevation 4000 feet. Owner, T. W. Atkinson, Estate. Agent, A. P. Barnhart, Bakersfield, California.

Two quartz veins known as the Sunshine and LaCrosse veins occur in the schist. The principal development is confined to the Sunshine Vein, which strikes N.  $80^\circ$  E. and stands vertical. The vein is from 6 to 12 inches wide, free-milling gold quartz. The course of the albite schist in this area is N.  $10^\circ$  E. The Sunshine Vein is cut by a number of faults which offset the vein a short distance. On the 400-foot level, at 57 feet west of the shaft, it is cut by a fault, which dips  $50^\circ$  SE. At 230 feet east of the shaft a north-south vein intersects the Sunshine Vein. This vein follows a vertical fault.

Development consists of a shaft 600 feet deep, with levels driven at 100', 200', 300', 400' and 500' and approximately 1000 feet of drifts.

Mine equipment consists of 25-h.p. hoist, air compressor and blacksmith shop and dwellings. Mill equipment comprises 3 stamps and cyanide plant. The production has been \$1,000,000. Idle.

Bibl: State Mineralogist's Report XIV, p. 512.

*Tropico Mines.* It comprises 12 patented claims and two 5-acre millsites, situated in Secs. 10, 11, 14 and 15, T. 9 N., R. 13 W., S. B. M., 5 miles northwest of Rosamond. Elevation 2800 feet. Owner, Tropico Mining and Milling Company; Clifford Burton, president; E. H. Cockran, secretary, Los Angeles.

The vein system consists of six parallel veins that follow fault fissure in rhyolite. These veins strike east and west, dip  $60^{\circ}$  S. and have widths varying from 6 to 10 feet.

Development work consists of shafts sunk on the Home, Fairview and Lida veins. This vein system is cut by a series of north and south faults that dip  $45^{\circ}$  W. The principal development work is on the Home claim. Here the main shaft has been sunk on an incline of  $60^{\circ}$  to a depth of 700 feet. At 80 feet in elevation below the collar of the shaft, the main haulage tunnel is driven 150 feet north to vein, with a drift 350 feet west of the shaft to a glory hole. On this level a drift has



Tropico mine and mill. Tropico, Kern County.

been run east on the Home Vein several hundred feet. The ore shoot developed on this level was 150 feet in length, with an average width of 6 feet. Average value of ore extracted is said to have been from \$5 to \$10 per ton in gold. There are seven levels driven on the vein at 100-foot intervals. Ore shoot west of shaft was 150 feet in length, with an average width of 6 feet, and has been stoped from the fifth level to the surface. A shoot of ore was developed east of the shaft on the seventh level and has been stoped for a length of 150 feet to No. 3 level. Crosscuts have been driven west of the shaft on No. 2, No. 3, No. 5 and No. 6 levels to No. 1 Vein, which has been stoped from No. 6 level to No. 2 level for a length of 100 feet, average width being 4 feet. About 150 feet west of shaft on No. 3 level, a crosscut has been driven north 700 feet to the Lida Vein. The Fairview shaft is located 1000 feet east of the Main shaft and sunk on an incline of  $60^{\circ}$  to a depth of 300 feet.

Mine equipment consists of 50-h.p. electric hoist; 320-cu. ft. Chicago pneumatic compressor driven by 75-h.p. motor; Deane duplex pump on



0-foot level, driven by 30-h.p. motor, capacity 70 gallons per minute. Mill equipment consists of ten 1000-pound stamps, driven by 30-h.p. motor; thirty-ton cyanide plant.

During the past two years the company has been treating the ore extracted from the Yellow Dog Mine. Six men are employed.

Bibl: State Mineralogist's Report XIV, p. 512.

*Urbana and Frank Mines.* (See North Sumner Gold Mines.) They are situated in the Cove Mining District, one mile north of Kernville.

Bibl: State Mineralogist's Reports XX, p. 39; XIV, pp. 512-513.

*Voss Consolidated Placer Mines.* It comprises 7 placer claims, known as the *Bond Buyer and Cash Register Group of Mines*, situated in Sec. 1, T. 30 S. R. 37 E., and Sec. 6, T. 30 S., R. 38 E., 3 miles north of Cantil. Owner, J. D. Voss, Garlock, California.

The gravels are quite unassorted and are tightly packed and cemented with 'caliche.' The gravels are reported to carry from 30 cents to \$2 per cubic yard.

Workings consist of a number of shafts sunk to bedrock, which is granite. The gravels are 6 to 15 feet thick and cover an extensive area on the south slope of the El Paso Range of mountains. All production which has been made has been by 'dry placer methods.'

*White Mines (Sidney).* These properties are located in Secs. 16 and 17, T. 30 S., R. 40 E., M.D.M., on the southeast slope of the Rand Mountains, about 4 miles southwest of Randsburg. Elevation 4300 feet. Holdings comprise 260 acres. Owner, A. C. White, Randsburg, California.

A series of parallel veins occur in schist and strike northeast and southwest. Widths of veins vary from 12 inches to 2 feet. The vein quartz is free-milling and carries from \$10 to \$100 per ton in gold.

Developments consist of a number of shafts, the deepest being 325 feet, with levels at 100', 200' and 300', with several thousand feet of drifts. Equipment consists of hoist, compressor, blacksmith shop and wellings. Six men employed. The property has a production record of \$250,000.

Bibl: State Mineralogist's Report XIV, p. 510.

*White Star Mine.* It comprises one claim situated in Sec. 11, T. 27 S., R. 32 E., M.D.M., in the Pioneer District, 32 miles north of Caliente. Elevation 4300 feet. Owner, E. A. Braden, Bodfish, California.

A narrow vein occurs in granite. The pay shoot worked was said to be 40 feet in length with an average width of 10 inches. Development consists of a tunnel 320 feet in length with 500 feet of drifts. Reduction equipment consists of a 2-stamp mill. The property is reported to have produced \$30,000. Idle.

Bibl: State Mineralogist's Report XIV, p. 513.

*Windy Mine.* It comprises 90 acres situated in Sec. 34, T. 29 S., R. 30 E., M.D.M., in the Rand District, one mile northeast of Randsburg. Elevation 3800 feet. Owner, *Randsburg Development Company*; W. J. Quackenbush, president; Neal Woods, secretary. Offices: Torrance, California. Oliver Phillips, superintendent.



Several parallel veins occur in schist. The ore is free-milling, high grade ore. Development consists of an incline shaft 225 feet deep and crosscut 100 feet on 200-foot level, with a winze 100 feet in depth. Levels have been driven on the vein at 50', 100', 150' and 200', with several thousand feet of drifts. Ore extracted is reported to carry from \$20 to \$40 per ton in gold. Mine equipment consists of 25-h.p. electric hoist and blacksmith shop. Mill equipment consists of 40-ton Joshua Hendy rod mill, amalgamation plates and concentrator. The company operated the property during 1927 and made some production. Idle.

Bibl: State Mineralogist's Report XIV, p. 513.

*Winnie Mine.* It comprises 20 acres situated in Sec. 11, T. 30 S., R. 40 E., M.D.M., about 3 miles southwest of Johannesburg, in the Stringer Mining District. Elevation 4000 feet. Owner, C. A. Koehn Gypsite, California.

A number of narrow parallel veins occur in schist. The ore is free-milling, carrying a small percentage of tungsten. Development consists of a number of shafts from 50 to 250 feet deep. Idle.

Bibl: State Mineralogist's Report XIV, p. 513.

*Whitmore Mine.* It comprises 10 claims totaling 160 acres, situated in Sec. 32, T. 11 N., R. 12 W., S. B. M.,  $3\frac{1}{2}$  miles south of Mojave, in Mojave Mining District. Elevation 2700 feet. Owner, W. K. Whitmore and J. E. Whitmore, Mojave, California.

Four parallel veins occur along a series of roughly parallel rhyolitic-porphry dikes. The general course of these porphyry dikes is N. 30° W., dip 60° E. The veins strike north to N. 30° W. and dip 60° E. Their widths vary from 2 to 6 feet.

Development consists of two shafts, one being sunk on the most westerly vein to a depth of 300 feet, on an incline of 75°, with levels at 100 and 200 feet. This shaft is sunk on the vein for a distance of 225 feet, then vertically for 75 feet in the footwall. The vein developed on these two levels has an average width of 3 feet and is reported to carry values in gold and silver of from \$6 to \$50 per ton. The other shaft is an incline shaft 100 feet deep. The vein developed is from 2 to 4 feet wide. The ore is free-milling, containing some pyrite. Average value is reported to vary from \$10 to \$20 per ton.

Equipment consists of 6-h.p. gas engine hoist; 10" x 10" compressor, driven by 30-h.p. gas engine; shops and dwellings. Two men are employed.

Bibl: State Mineralogist's Report XIX, pp. 152-163.

*Yellow Aster Mine.* This property is the largest gold producer in Kern County and one of the oldest mines in the Randsburg District. The total production of the mine is estimated to have been about \$10,000,000. Of this amount, approximately \$3,000,000 has been paid in dividends. The property comprises 47 patented claims and 6 unpatented claims, totaling 796 acres, situated in Secs. 2, 3, 34 and 35, T. 29 and 30 S., R. 40 E., M.D.M., in the Rand Mining District, about one mile west of Randsburg. The property has been under operation since 1896. Owner, Yellow Aster Mining and Milling Company; Albert Aucker, president; Arthur Asher, vice-president; Dr. Rose L. Burcham,

Secretary; W. F. Allen, general manager. Offices, 602 Transportation Building, Los Angeles.

The orebody is a network of quartz veins and stringers in quartz monzonite and schist. The gold occurs both in these veins of quartz and stringers and in the quartz-monzonite adjacent to the veins. The present low-grade orebody consists of a triangular block of mineralized quartz monzonite, which is bounded on the east by the Hanging Wall Fault, on the north by the Jupiter Fault and on the southwest by the Footwall Fault. This orebody is about 800 feet in width, 1000 feet in length and was worked down to the third level. There are six parallel veins that have been developed in this area which strike northwest and southeast. The dips vary from  $30^{\circ}$  northeast to vertical. The Jupiter Fault strikes N.  $75^{\circ}$  E., dipping to the north at an angle of  $40^{\circ}$ ; the Hanging Wall Fault strikes N.  $30^{\circ}$  W., dipping  $45^{\circ}$  NE.; the Footwall Fault strikes N.  $60^{\circ}$  W., dipping  $40^{\circ}$  NE. The high-grade orebodies formerly mined occurred along vertical fissures and fracture zones and also beneath the low-dipping premineral faults which bound the present low-grade orebody on the north and east. The vertical orebodies strike northwest and vary in width from small veins to over 100 feet. The largest orebodies occurred in the northwest fissures and fracture zones and had a length of about 800 feet and a thickness of 20 to 75 feet. The Rand vertical vein was worked for a length of 500 feet, and had an average width of 15 feet. It was worked to a depth of 400 feet. The Price Vein was worked for a length of 500 feet. The average width was 10 feet and it was mined to a depth of 400 feet. The orebodies that occur as mineralized zones underlying the premineral faults possess well-defined hanging walls formed by the gouge along the fault. This ore is composed of mineralized country rock usually quartz monzonite and schist, with very little vein quartz. Orebodies of this type occurred beneath Jupiter fault, along the line of the midway tunnel. They were from 200 to 300 feet in length and varied from 4 to 16 feet in thickness. The ore extracted from these rich veins is stated to have had a value of from \$25 to \$50 per ton. The estimated tonnage of the low-grade oxidized ore that constitutes the present orebody is stated to be one-half million tons, with a gross value of \$1.75 per ton. A new orebody has been developed on the north side of the glory hole along the Jupiter Fault about 100 feet in elevation about the Rand level. A tunnel has been driven southwest 300 feet. At 100 feet southwest of the portal, a shoot of ore was encountered which has been developed for 200 feet in length. The vein varies in width from 4 to 13 feet. It strikes northeast and dips  $30$  to  $35^{\circ}$  to the north. The footwall is quartz-monzonite. On the footwall there is a carbonized gouge 6 to 12 inches thick. The mineralized quartz occurs above the gouge. Average value of the ore extracted is reported to be \$6 per ton. Several raises have been put up in this shoot of ore for a distance of 115 feet. The past months mill run on ore from this orebody showed a recoverable value of \$5.50 per ton. The principal development work under way at the time the property was visited was confined to raises above the Rand level in blocks of ground above the floor of the glory hole. Some development was being done on the 100 and 300 foot levels on the Prince Vein.



**Mine workings:** The mine is developed by approximately 15 miles of workings and three shafts. The workings are distributed among fourteen levels, of which the Rand level, the first, second and third levels are the most important. Three shafts have been sunk from the floor of the glory hole. The main shaft is sunk on an incline of 44° to a depth of 250 feet. The shaft follows down the footwall fault. The Hercules shaft is sunk on an incline of 40° to a depth of 450 feet and is located between the Jupiter and Hanging Wall faults. The Rand vertical shaft is located 150 feet southwest of the Hercules shaft and has been sunk to a depth of 450 feet. At the time of the writer's visit to the property, in October, 1928, the mining was done partly on company account and by a system of leasers. Ten leases were being worked in the mine, two men composing the party working each lease. Leases within the mine are given on the basis of a 50% royalty, on ore running \$10 and above. The company furnishes tools and air. The leasers furnish their own powder and load the ore on cars.

Mine equipment consists of one Chicago pneumatic compressor; one Norwalk compressor; thirty 3-ton ore cars; three electric hoists; and drills; blacksmith and machine shops.

**Mill equipment:** A 4-ton Plymouth locomotive hauls a train of 3-ton cars from the mine on the Rand level to crushing and screening plant. From storage bin with a capacity of several hundred tons divided into compartments to segregate company ore from ore from leases, the ore passes through No. 4 Gates gyratory crusher, then by belt conveyor to bins. There are thirty 1000-lb. stamps under operation, ten stamps of which are operated on ore from leasers, the remaining stamps on company ore.

The ore is crushed to pass 40-mesh screen; then the pulp flows over amalgamation plates. A recovery of 85% is made on the plates. Slimes are classified and concentrated on two Wilfley tables. The concentrates saved on tables are ground in amalgamation barrel and \$15 per ton in gold is recovered. Fifty-two men are employed.

Bibl: State Mineralogist's Report XIV, p. 514; Bull. 95, 'Geology and Ore Deposits of the Randsburg Quadrangle' by Carlotta D. Hulin, pp. 121-125.

**Yellow Aster Tailings.** George Carson and Frank K. Wyman, of Randsburg, have secured a lease on a royalty basis, on the tailings of the Yellow Aster mill. They have installed a cyanide plant having a capacity of 500 tons per 24 hours. The tailings are delivered to three leaching tanks by dragline scraper operated by a 52-h.p. hoist. It is stated that the heads carry from 50 cents to \$1.50 per ton. Total operating costs are said to be 30 cents per ton. Four men are employed.

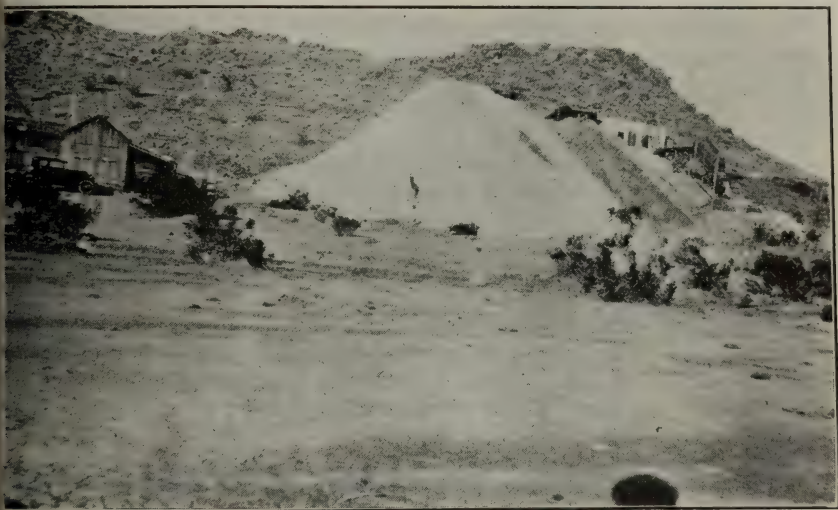
**Yellow Dog Mine.** It comprises 8 claims, totaling approximately 16 acres, located in Secs. 29, 32, T. 11 N., R. 12 W., S. B. M., 3 miles south of Mojave. Owner, Yellow Dog Mining Company; P. O. Paulson, president; Walter B. Kibby, secretary; Bert Fisher, vice president; and H. C. Burton, manager. Offices: New Orpheum Building, Los Angeles.

During the early part of 1922, Mr. Percy Wegman, of Mojave, discovered an outcrop of quartz carrying free gold on this group of claims. This discovery of high grade gold ore was the most important made in the district in recent years and has caused a revival of interest in the



istrict. The vein strikes north and dips  $60^{\circ}$  to the east. It has an average width of 6 feet, with a maximum width of 10 feet. The high grade gold quartz occurs on the hanging wall, with a vein of spar from 2 to 8 feet wide, heavily stained with manganese on the footwall. The vein occurs on the eastern slope of a small butte of rhyolite-porphyry. It is stated that samples taken from the spar vein will average \$3 per ton, while the average value of samples from 4 feet of vein quartz was better than \$25 per ton.

Developments: At an elevation of 2800 feet, a shaft has been sunk in an incline of  $60^{\circ}$  to a depth of 300 feet. Levels have been driven at 100, 200 and 300 feet. From the 100-foot level to the 300-foot level, the shaft is in the footwall of the vein, which is granite. The orebody developed between the 100-foot level and the surface is 200 feet in length and has an average width of 6 feet. This shoot of ore is located north of the shaft. On the 300-foot level this ore shoot was cut 280 feet north



Yellow Dog Mine, Mojave.

of the shaft. At this point a winze has been sunk to a depth of 30 feet. At 120 feet north of shaft, a crosscut was driven 300 feet west in the footwall in the hopes of intersecting a parallel vein. In 1927, 576 tons of ore was treated in the Tropico Mining Company's mill which had an average value of \$30 per ton. The total production is reported as \$70,000.

Mine equipment consists of 15-h.p. electric hoist; 10" x 12" Chicago pneumatic compressor driven by 50-h.p. motor. Electric power is secured from the Southern California Edison Company. Six men are employed.

Bibl: State Mineralogist's Report XIX, pp. 163-164.

*Yellow Dog Extension Mine.* It comprises 5 claims situated in the Mojave Mining District, in Sec. 33, T. 11 N., R. 12 W., S. B. M., 3 miles south of Mojave. Elevation 2800 feet. Owner, Yellow Dog Extension

Mining Company; E. M. Brown, president; Luther Emery, secretary Offices, H. W. Hellman Building, Los Angeles.

Two parallel veins have been developed on the property, the more prominent being the Russian Boy vein. The veins strike N. 30° W. and dip 45° E. The Russian Boy vein has a width of 6 feet. The country rock is granite and rhyolite-porphyry. The vein filling is quartz and calcite, stained with manganese and iron oxide. The quartz shows free gold associated with pyrite.

Development consists of a vertical shaft 150 feet deep and a tunnel 150 feet in length and one stope 75 feet in length. Idle.

Bibl: State Mineralogist's Report XIX, p. 164.

*Zenda Mine.* It comprises 900 acres, located in Sec. 30, T. 30 S., R. 38 E., M. D. M., in the Amalie Mining District, 14 miles northeast of Caliente. Elevation 3000 to 3500 feet. Owner, Zenda Gold Mining Company, 120 Broadway, New York; John A. Moran, Jr., president; J. R. Gemmell, secretary.

The vein occurs as a massive outcrop of quartz in quartz-porphyry, strikes northeast and dips 35° N. The width of the vein varies from 30 to 50 feet and where exposed in the glory hole, it has a width of 50 feet. The known pay shoot is 300 feet in length, with an average width of 30 feet.

Workings consist of a number of tunnels from 150 to 600 feet in length and two glory holes. The main tunnel haulage is driven N. 30° W. about 350 feet, from which point an upraise connects with the glory hole. The ore mined from the glory hole has a value of \$3 per ton, carrying 0.08 ounces in gold and 3.5 ounces in silver. Mill equipment consists of 150-ton cyanide plant.

The property was operated from August 1, 1923, until September, 1927, when operations were suspended. The Zenda Gold Mining Company has acquired holdings in the Calico District, San Bernardino County. The company plans to ship all mining and mill equipment from the Zenda Mine at Calico. Idle.

Bibl: State Mineralogist's Reports XIV, p. 515; XX, pp. 41-42.

#### IRON

Deposits of iron ore occur at Woody, in Secs. 10 and 15, T. 20 S., R. 20 E., M. D. M., and at the foot of Mt. Breckenridge in Sec. 17, T. 9 N., R. 21 W., S. B. M. Practically no development work has been done on these and their commercial value is doubtful on account of cost of transportation.

*Iron Mountain Deposit.* It is located in Secs. 10 and 15, T. 26 S., R. 29 E., M. D. M., about 1½ miles south of Woody. The deposit is about 300 feet wide, consisting of magnetite in mica schist.

Bibl: State Mineralogist's Report XIV, p. 516.

*Mount Breckenridge Deposit.* It is located at the foot of Mt. Breckenridge, in Sec. 4, T. 29 S., R. 31 E., M. D. M., about 20 miles north of Caliente. The outcrop of hematite is from 10 to 200 feet in width, occurring in mica schist. It strikes northeast and southwest and dips 45° W.

Bibl: State Mineralogist's Report XIV, p. 516.

*San Emidio Deposit.* It is located in Sec. 17, T. 19 N., R. 21 W., S. B. M., and consists of a massive outcrop of hematite from 50 to 400 feet in width.

Bibl: State Mineralogist's Report XIV, p. 516.

#### LEAD AND SILVER

The discovery of rich silver ore in the Rand District in the spring of 1919 caused the development of the California Rand Silver Mine, which to date has produced in excess of \$15,000,000. This property is located in San Bernardino County and the large orebodies developed are located northeast of the boundary line of Kern County.

However, the development of this famous silver mine caused much excitement and considerable prospecting and development work was done on claims and properties in Stringer District in hopes of developing the southwest extension of the silver-bearing schist formation. This activity also caused the discovery of lead-silver deposits in the El Paso Range of mountains.

Previous to 1912, considerable silver was produced from the gold ores of the mines of the Amalie Mining District which is situated 18 miles northeast of Caliente. The bullion produced from the Amalia Mine, one of the famous producers of this district, is stated to have carried 80% silver and 20% gold.

#### Mines:

*Beehive Mine.* It comprises 10 claims located on the south slope of El Paso Mountains, seven miles north of Randsburg. Owner, *Kern Rand Mines, Inc.*, Bakersfield, California.

Narrow veins occur carrying values in lead, silver and gold. Development consists of shallow shafts and about 100 feet of tunnels. Idle.

*Churchill Group of Claims.* It comprises 50 acres, situated in Sec. 20, T. 28 S., R. 40 E., M. D. M., in the Rademaker Mining District, 9 miles northwest of Randsburg, on the south slope of El Paso Mountains. Owner, J. A. Foisee, Randsburg, California.

Several narrow veins occur in the granite. Workings consist of shallow opencuts and tunnels on the different veins. The veins developed have a width of 12 to 18 inches. The principal workings are confined to a vein that strikes northwest and dips 18° S. Upper tunnel is 100 feet in length. At 75 feet in elevation below this tunnel, a crosscut tunnel is driven northeast 60 feet intersecting the vein. The ore is said to carry high values in silver. Idle.

*Hummer Mine.* It consists of 7 claims located in El Paso Mountains just south of El Paso Peak, about 9 miles north of Randsburg.

A narrow vein of quartz occurs in granite. The values are chiefly in the form of argentiferous galena, with low values in gold. Development consists of an incline shaft 114 feet deep. Idle.

Bibl: Bull. 95, Geology and Ore Deposits of the Randsburg Quadrangle, p. 135.

*Mizpah-Montana Mine.* It comprises 20 acres located in Secs. 1 and 3, T. 30 S., R. 40 and 41 E., M. D. M., in the Rand Mining District, 1½



miles southeast of Randsburg. Elevation 3800 feet. Owners, Mizpah-Montana Mining Company; Herman T. Miller, president; Frank Smith, secretary.

The country rock is granite and schist. Two parallel veins, which strike N. 40° E. and dip 65° SE., occur in the granite. Width of veins is from 8 to 12 inches. The vein material is a dark gray silicious filling more or less brecciated. It is mineralized with pyrite and stibnite. The silver minerals are cerargyrite and miargyrite. Two small bunches of ore carrying high silver values were encountered on the 100-foot level near the shaft.

Development consists of a 2-compartment vertical shaft 700 feet deep, with drifts on the 100', 200', 500' and 700' levels, amounting to several thousand feet of horizontal workings. Idle.

Bibl: State Mineralogist's Report XIX, pp. 167-8; Bull. 95, p. 138.

*Mizpah Nevada Mine.* It comprises 4 claims, situated in the Rand Mining District, in Secs. 1 and 6, T. 30 S., R. 40 and 41 E., M. D. M., 1½ miles southeast of Randsburg. Elevation 3850 feet. Owner, Mizpah-Nevada Mining Company; M. F. Pierson, president; F. J. Burns, secretary, Bakersfield, California.

Three parallel quartz veins occur in the granite. They strike N. 40 to 60° E. and dip from 75° to vertical. The width of veins vary from 8 to 12 inches. Development consists of 2-compartment vertical shaft 150 feet deep, with a crosseut on the 150-foot level. Idle.

Bibl: State Mineralogist's Report XIX, p. 168; Bull. 95, p. 138.

*Monarch Rand Mine.* It comprises the Jersey Lily group of claims, situated in Secs. 1 and 12, T. 30 S., R. 40 E., M. D. M., in the Rand Mining District, 1½ miles southeast of Randsburg. Owner, Monarch Rand Mining Company; E. P. Wallace, president, Randsburg, California.

The vein is 3 feet wide and occurs on the hanging wall of a quartz-latite dike. It strikes N. 40° E. and dips 60° E. There are also several north and south stringer veins in the schist. The vein filling is a very silicious schist, mineralized with pyrite and stibnite, with low values in silver. The principal ore found carries values in gold.

Development consists of two shafts sunk on the Jersey Lily No. 1 Claim; No. 1 Shaft is a vertical shaft 500 feet deep, with levels at 120', 170' and 220'. No. 2 Shaft is 300 feet deep. Mine equipment consists of single-drum electric hoist, compressor, blacksmith shop and dwellings. Idle.

Bibl: Bull. 95, Geology and Ore Deposits of the Randsburg, Quardrangle, pp. 138-139.

*Rand Contact Mine.* It comprises 4 claims, being approximately 80 acres, located in Sec. 7, 12, 13 and 18, T. 30 S., R. 40 and 41 E., M. D. M., in the Rand Mining District, 3 miles southwest of Johannesburg. Owner, Rand Contact Mining Company, Los Angeles; S. G. Dixon, president; L. A. Shaftner, secretary.

A quartz vein occurs on the contact of the schist and granite, striking northeast and southwest and dipping 45° to the southeast. Width

vein is 12 inches to 2 feet. Two parallel faults occur north and south of the shaft which strike N.  $45^{\circ}$  W. and dip to  $70^{\circ}$  NE.

Development consists of two-compartment vertical shaft 100 feet deep, with a crosscut on 100-foot level driven southeast to intersect the main shaft.

Equipment consists of 10-h.p. gas engine hoist; cars and blacksmith shop. Idle.

Bibl: State Mineralogist's Report XIX, p. 168.

*Rattlesnake Group of Claims.* It consists of 2 claims situated on the south slope of the El Paso Mountains, about 5 miles north of Saltdale. Owner, Mrs. J. S. Bishop, Cantil, California.

A series of parallel veins occur in the granite, strike northwest and southeast; the dips vary from  $40$  to  $60^{\circ}$ . The width of the veins vary from 12 inches to 2 feet. The vein quartz is mineralized with cerussite, galena and copper oxides, with values in gold and silver. Developments consists of shallow shafts and open cuts, the deepest shaft being 10 feet. Idle.

*St. Lawrence Rand Mine.* It comprises 180 acres, located in Sec. 1, T. 30 S., R. 40 E., M. D. M., 2 miles southeast of Randsburg. Elevation 3680 feet. Owner, *California Rand Silver, Inc.* Under lease to the St. Lawrence Rand Mining Company, Bakersfield, California; J. A. Dulgar, president; E. H. Richards, secretary.

Two parallel quartz veins occur in the schist. They strike N.  $70^{\circ}$  E. and dip  $65^{\circ}$  S. Widths vary from 12 inches to 4 feet. The vein lining is quartz, calcite and mineralized schist, the mineral contained being pyrrargyrite, stephanite, cerargyrite, stibnite and pyrite, with some gold values.

Development consists of two shafts sunk on the K. C. N. vein, No. 1 shaft being 275 feet deep, on an inclination of  $67^{\circ}$ . No. 2 shaft is an incline shaft 300 feet deep. The main development work has been confined to No. 2 shaft. Levels have been driven at 100', 200' and 400', with several thousand feet of drifts. The principal silver ore developed on the property was found on the 240-foot level, about 200 feet east of the shaft. This shoot was about 200 feet east of the shaft. It was 40 feet in length with an average width of 4 feet. A shipment of 6000 pounds of ore had an average value of \$75 per ton. It is reported that the ore developed will carry from 5 ounces to 20 ounces of silver per ton, with \$2 to \$5 per ton in gold.

Mine equipment consists of 35-h.p. motor; blacksmith shop; 2" x 10" Ingersoll-Rand compressor driven by a 75-h. p. motor; and buildings. Idle.

Bibl: State Mineralogist's Report XIX, p. 170; Bull. 95, p. 143.

*Summit Group of Mines.* It comprises 15 claims situated on the east slope of Cook Mountain, about  $2\frac{1}{2}$  miles southeast of Isabella. Elevation 5000 feet. Owner, *Pacific Mines Corporation*; J. F. Erisman, president; Edmond Nichols, secretary, Los Angeles.

The vein is 2 to 5 feet in width. The ore is galena, carrying silver values. Workings consist of shallow shafts and open cuts on the Redeemer Claim. A shipment of 30 tons of ore was made to Selby Melting Company in 1928. Idle.

*Treasure Hill Mine.* It comprises one claim known as Treasure Hill, located in Sec. 1, T. 30 S., R. 40 E., M. D. M.,  $1\frac{1}{2}$  miles southeast of Randsburg. Elevation 3750 feet. Owner, Treasure Hill Mining Company; Fredric Downer, president; George Rutherford, secretary Bakersfield, California.

Two quartz veins occur in the schist; one strikes N.  $30^{\circ}$  E. and the other N.  $55^{\circ}$  E., with dip  $60^{\circ}$  SE. Widths vary from 12 inches to 1



Fifty-ton rotary furnace. Cuddeback Cinnabar Mine. Keene, Kern County.

feet. Development consists of a vertical 2-compartment shaft 600 feet deep, with levels at 400 and 500 feet.

Mine equipment consists of 20-h.p. gas engine hoist; blacksmith shop and cars. Idle.

Bibl: State Mineralogist's Report XIX, pp. 170-171; Bull. 95, pp. 143-144.

*White Horse Mine.* It comprises 11 acres located in Sec. 1, T. 30 S., R. 40 E., M. D. M., 2 miles southeast of Randsburg. Elevation 3550 feet. Owners, White Horse Rand Mining Company; A. Sager, president; C. Campbell, secretary, Selma, California.

Two parallel veins occur in the schist northeast of the shaft. They strike N.  $30^{\circ}$  E. and N.  $55^{\circ}$  E. and dip  $50^{\circ}$  SE. Widths vary from 12 inches to 2 feet. Six shafts have been sunk on these veins to depths of 50 feet. The principal development consists of 2-compartment vertical shaft 200 feet deep. This shaft intersected No. 1 vein at a depth of 120 feet.

Mine equipment consists of 20-h.p. gas engine hoist. Idle.

Bibl: State Mineralogist's Report XIX, p. 171; Bull. 95, p. 144.

#### QUICKSILVER

*Cuddeback Cinnabar Mine.* It comprises 238 acres situated in Sec. 27, T. 31 S., R. 32 E., M. D. M., 3 miles northeast of Woodford, a



tation on the Southern Pacific Railroad. Owner, Cuddeback Cinnabar Corporation; C. G. Cuddeback, president, Tehachapi, California. Under option to C. D. Holmes, Santa Ana, California.

The country rock for several miles around is granite and a white rhyolite dike traverses the granite with a nearly east and west strike. The dip of this rhyolite dike is north about  $45^{\circ}$  and it has a width of about 60 feet. The dike rock is a somewhat porous, finely granular porphyritic-rhyolite, showing quartz and orthoclase phenocrysts under the microscope. Cinnabar crystals are disseminated through the ground-mass, in some places to such an extent as to give the whole rock pink color. The richer accumulations of the ore appear to be associated with certain cross-fissures in the dike which are marked by the presence of brown clay seams. The mineralized portion of the dike is about one-third mile long.

Development work consists of several short adits, crosseuts, drifts and three opencuts. At time of visit to the property, work was confined to an opencut about 400 feet north of the plant on the east slope of the hill. Ore from these workings is trammed over surface tram to bins at plant, a distance of 400 feet.

The ore from bins is fed to an 8" x 10" Blake crusher, where it is broken to pass  $1\frac{1}{2}$ " ring. The crushed material is elevated to a fine ore bin, then is fed by Shaker feeder to Jackrabbit pipe feeder direct to 8-foot diameter by 18-foot rotary furnace. The plant has a capacity of 50 tons per 24 hours. The property has produced \$150,000. Six men are employed.

Bibl: Bull. 78 Quicksilver Resources of California; pp. 47-48; State Mineralogist's Report XVII, p. 314.



Opencuts on mineralized dike. Cuddeback Cinnabar Mine. Keene, Kern County.

#### TUNGSTEN

The production of tungsten ore on a commercial scale began in the Stringer District in 1905. Up to the early part of the year, 1915, the

Atolia District in western San Bernardino County, with the adjoining Stringer District in Kern County, was practically the only producing area of any consequence in California. The Stringer District, so-called because of its being characterized by narrow stringers and seams of quartz in schist, is on the eastern slope of the Rand Mountains. These stringers and narrow quartz veins have been worked for years for their gold content. There are other associated stringers carrying scheelite. Though somewhat closely associated, the gold and tungsten for the most part, do not seem to be found in the same veins. From the placer wash in this area considerable tungsten and gold have been extracted. A portion of this placer wash may have been derived from the Rand Mountains. During the latter part of 1915 and early months of 1916, because of the high prices prevailing at that time, there was considerable activity in mining tungsten ores in the Stringer District which lasted to the year 1920 when the mines were shut down owing to low prices due to excess stocks following the war. In recent years there has only been a limited amount of work attempted in the mining of tungsten ores in Kern County. The tungsten ore that occurs in the Stringer District is scheelite (calcium tungstate). Scheelite also occurs in the Amalie, Keys and Rand districts, where it is usually associated with gold-bearing veins.

#### Mines.

*Bald Mountain Tungsten Deposit.* It is situated on the northeast slope of Bald Mountain, in Sec. 14, T. 27 S., R. 32 E., M. D. M., 5 miles southwest of Isabella. Elevation 3600 feet.

Scheelite occurs in two parallel quartz veins which strike northeast, with a slight dip to the southeast. Scheelite crystal occur disseminated through the quartz associated with iron pyrite. The outcrops of these veins can be traced for 300 feet, with widths varying from 3 to 6 feet. These veins are about 500 feet apart and occur in a biotite granite. The ore mined is said to have carried from 0.5% to 1%  $\text{WO}_3$ . Idle.

Bibl: State Mineralogist's Report XVII, p. 315.

*Capitola Mine.* It comprises a group of claims located in the Stringer District, in Secs. 11 and 12, T. 30 S., R. 40 E., M. D. M., 2 miles south of Randsburg. Owner, Capitola Mining Company, Los Angeles.

Development consists of shaft 150 feet deep. Mine equipment consists of hoist and shops. Mill equipment consists of a 20-ton concentration mill. Idle.

*King Tungsten Mine.* It is situated  $2\frac{1}{2}$  miles northeast of Havilah, on the southeast slope of Bald Mountain and 25 miles northeast of Caliente. Elevation 3200 feet. Owner, King Tungsten Mining Company, Los Angeles.

Scheelite occurs in quartz veins, associated with iron pyrite in a biotite granite. There are two parallel veins, from 3 to 5 feet in width and about 25 feet apart. These veins strike N.  $40^\circ$  W. and dip  $70^\circ$  SE.

Developments consist of a tunnel 115 feet in length and a number of shallow opencuts on the two veins. The ore mined is reported to have carried 1.14%  $\text{WO}_3$ . Plant has been dismantled and the property has been idle since 1920.

Bibl: State Mineralogist's Report XVII, pp. 315-316.



*Radcliffe Mine.* It comprises 3 claims situated in Sec. 12, T. 30 S., R. 40 E., M.D.M., about 2 miles southeast of Randsburg in the Rand Mining District. Owner, J. H. Radcliffe, Randsburg, California. Elevation 3700 feet.

Scheelite occurs in a narrow vein in schist which strikes east and has a general dip to the south. Development consists of a vertical shaft 150 feet deep, with levels driven on the vein at 65', 100' and 150'. Idle.

Bibl: State Mineralogist's Report XVII, p. 316.

*Royal Bohee Group of Mines.* It is situated on the west slope of the Rand Mountains, 7 miles east of Garlock, a station on the Southern Pacific Railroad. Owner, A. Powell, Randsburg, California.

Scheelite occurs in stringers of quartz, varying in width from a mere seam to 6 inches, in a green amphibolite schist. Development consists of a number of tunnels from 50 to 240 feet in length. Idle.

Bibl: State Mineralogist's Report XVII, p. 316.

*Sunset Group of Claims.* It comprises 9 claims, situated on a low, isolated hill at the west border of the Rand Mountains, 6 miles southeast of Garlock, a station on the Southern Pacific Railroad. Elevation 2800 feet.

The deposit consists of narrow quartz stringers 2 to 6 inches wide in a belt of limestone carrying scheelite. A strong vein of calcite, carrying scheelite occurs at contact of limestone and schist. This vein strikes north and has a width of 6 inches. Idle.

Bibl: State Mineralogist's Report XVII, p. 316.

## NON-METALLIC MINERALS

The rapid growth of the cities on the Pacific Coast and especially the city of Los Angeles has caused an increasing demand for both industrial and structural materials. Kern County has a great variety of commercial minerals which are used locally and a large tonnage of both industrial and structural materials are shipped to the manufacturing centers along the Pacific Coast. The more important of these minerals thus far exported as shown by the output are: asbestos, clay, cement, feldspar, fuller's earth, gypsum, limestone, magnesite, marble, onyx, soapstone and sulphur.

### ASBESTOS

*San Emigdio Asbestos Deposit.* It comprises a group of 3 claims situated 3 miles northwest of Cuddy Ranch and west of Chandlers, on the Ridge Route. Owner, R. C. Cuddy, Cuddy Canyon, California. Under option to H. M. Musser, Collin Timmons and F. L. Sexton, of Los Angeles.

Asbestos of the amphibole variety occurs in a belt of serpentine, on a ridge west of San Emigdio Canyon. This belt of serpentine strikes northwest and southeast. Asbestos occurs along horizontal bedding planes in the serpentine. The widths exposed along these bedding planes is from 6 to 8 inches.

Developments consist of short tunnels and opencuts. Three men are employed.



Asbestos also occurs in a serpentine belt in Jawbone Canyon, in Sec. 7, T. 30 S., R. 36 E., M. D. M. It is in the form of chrysotile. The vein is 10 feet wide and strikes northeast with dip 40° S.

#### CLAY

The alluvial silt of the San Joaquin Valley, in the vicinity of Bakersfield, has been in use for many years for the manufacture of common brick. A deposit of high grade pottery clay occurs 4 miles north of Rosamond, a station on the Southern Pacific Railroad. In former years considerable clay was mined and shipped to Los Angeles for the manufacture of pottery. The clay deposits of the county are fully described in bulletin No. 99, Clay Resources and the Ceramic Industry of California, pp. 88-90.

#### Plants.

*Bakersfield Rock and Gravel Company.* Owners, A. H. Kaspe and W. J. Watters, Bakersfield, California.

Bibl: Bull. 99, p. 89.

*Bakersfield Sandstone Brick Company,* James Curran, manager, 501 Sonora Street, Bakersfield, California. The capacity of the plant is 40,000 brick per day. Fourteen men are employed.

Bibl: State Mineralogist's Report XIV, p. 477; Preliminary Report No. 7, p. 48; Bull. 99, p. 89.

*Kern County Brick Company.* It comprises 12 acres in Sec. 21, T. 29 S., R. 28 E., M. D. M., on the eastern outskirts of Bakersfield. Owner, *King Lumber Company*; Elmer King, president, Bakersfield, California. The plant has a capacity of 37,000 brick per day. Ten men are employed.

Bibl: Bull. 99, p. 89.

*Muroc Silt Deposit.* The deposit of silt is situated in Secs. 21, 22 and 23, T. 10 N., R. 9 W., on Muroc Dry Lake, about 5 miles east of Muroc, a station on the Santa Fe Railroad. Owner, V. E. Britton, Muroc, California.

This silt occurs on Muroc Dry Lake to a depth of two feet, overlying a blue clay. The material is being shipped to the oil fields of the Los Angeles Basin for use as rotary mud. The material is loaded into trucks and hauled to loading platform where it is dumped directly into railroad cars. During 1928, 40,000 tons was shipped to Los Angeles. Ten men are employed.

*Rosamond Clay Deposit.* It comprises 40 acres situated in the NW $\frac{1}{4}$  of the SE $\frac{1}{4}$  of Sec. 11, T. 9 N., R. 13 W., S. B. M., 4 $\frac{1}{2}$  miles northwest of Rosamond, a station on the Southern Pacific Railroad. Owner, H. E. Titus, Rosamond, California.

The deposit is a flat bed of clay inclosed in felsite porphyry, overlain by a red-colored porphyry capping. The deposit is 300 feet wide, 700 feet long and 500 feet deep. Development consists of tunnel 200 feet in length and an open pit. The clay is a pottery clay of good quality. Idle.

*Webb Clay Deposit.* This deposit is situated one mile west of the Rosamond clay deposit and 4 miles northwest of Rosamond. Owner, W. S. Webb, Rosamond, California.

The deposit is probably an extension of the same clay bed as developed in the Rosamond clay deposit. Development consists of a short tunnel 50 feet in length. This tunnel exposes a clay bed 10 feet thick. Idle.

Bibl: Bull. 99, p. 90.

*Williams Clay Deposit.* It comprises 160 acres, situated in Secs. 34 and 27, T. 30 S., R. 36 E., M. D. M., 1 mile south of Jawbone Canyon and about 8 miles north of Cantil, a station on the Southern Pacific Railroad. Owner, Hamp Williams, of Los Angeles. The property is under lease to Potters, Inc., of El Cerrito. C. P. Stone, 836 Pomona Avenue, West Berkeley, California, is interested in the company.

The deposit of kaolin occurs in a belt of rhyolite that strikes north-west. The belt of rhyolite is about 2000 feet wide and can be traced for several miles. The rhyolite is highly kaolinized and is white in color and free of iron. The material is being quarried for shipment to San Francisco. Two men are employed.

#### FELDSPAR.

*Townsend Feldspar and Silica Deposit.* It comprises two claims situated in the SW $\frac{1}{4}$  of Sec. 6, T. 9 N., R. 12 W., S. B. B., 2 miles northwest of Rosamond, a station on the Southern Pacific Railroad. Elevation 2250 feet. Owners, C. W. Townsend and A. E. Townsend, Mojave, California.

The deposit consists of a bold outcrop of silica and feldspar in granite. The surface exposure is about 100 feet wide and several hundred feet in length.

Development consists of a vertical shaft 100 feet deep and several benches. The feldspar developed by this shaft is said to be 30 feet thick. It strikes N. 60° E. and dips 40° W. The feldspar is pink to brown in color. The silica is white and free from iron. During 1927 the property was operated by N. W. Sweetzer, of Los Angeles, who shipped a large tonnage of feldspar to Los Angeles.

Equipment consists of 6-h.p. gas engine hoist; blacksmith shop; cars and track. Idle.

#### FULLER'S EARTH.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color. Some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils and for special chemical purposes. Clays of the montmorillonite, bentonite and alloysite group are utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products. Commercial deposits of bentonite occur in the El Paso Range of Mountains, in the neighborhood of Cantil and Tehachapi. The most important occurrence of fuller's earth in the county is located 18 miles north of Bakersfield.

*California Fuller's Earth Deposit.* It comprises 140 acres situated in Sec. 14, T. 27 S., R. 28 E., 18 miles north of Bakersfield. C. Weichelt, Bakersfield, owner.

The deposit varies from 15 to 50 feet in depth and is many acres in extent. The fuller's earth is overlain by a thin bed of soil which was first removed and then the earth was taken out in open pits. This

deposit was first opened up in 1898, and considerable tonnage was shipped following this period but with the development of the morillonite and bentonite clays, there has been no production in recent years.

Analysis of the earth shows:

	Per cent
Silica ( $\text{SiO}_2$ ) -----	54.32
Alumina ( $\text{Al}_2\text{O}_3$ ) -----	18.88
Iron Oxide ( $\text{Fe}_2\text{O}_3$ ) -----	6.50
Lime ( $\text{CaO}$ ) -----	1.00
Magnesia ( $\text{MgO}$ ) -----	3.22
Loss on ignition -----	11.86
Alkalies -----	4.21



Filtrol Company's Clay Deposit, Tehachapi, Kern County

A comparative test of this earth with the English fuller's earth showed that 10 pounds of it equaled 9.75 pounds of the English earth. Idle.

Bibl: State Mineralogist's Report XIV, p. 480-481; Bull. 38, p. 274-275.

*Duran Bentonite Deposit.* It comprises 40 acres situated 4 miles north of Rand, a station on the Southern Pacific Railroad. Owner J. R. Duran, Randsburg, California.

The deposit is 4 to 12 feet thick, overlain with basalt. The bentonite is white to pink in color. The bed is exposed by shallow opencuts. Idle.

*Filtrol Company's Clay Deposit.* It comprises 1280 acres, situated in Sec. 2, T. 32 S., R. 34 E. and Sec. 34, T. 31 S., R. 34 E., M. D. M., miles northeast of Monolith. William Cuddeback, Monolith, California owner. Under lease to Filtrol Company; T. L. Robinson, president; T. H. Henderson, secretary, Bartlett Building, Los Angeles.

This deposit of clay was discovered in May, 1927, by William Cuddeback and the Filtrol Company commenced operations in December, 1927. Exposures of bentonite clay occur on both the above mentioned



ections. The bed of clay strikes northwest and southeast and dips to  $10^{\circ}$  to the south. It can be followed for a considerable distance, and has been exposed by an opencut for a distance of 500 feet. The bed where exposed in this opencut is from 6 to 8 feet thick, overlain by soil overburden from 6 to 12 feet thick. The clay where freshly exposed has a greenish color but when dry, it is white.

The overburden is first stripped off and then the bed of clay is mined by open pit method. The clay is transported in cars to loading bins, from which it is hauled by truck to a loading platform at siding on the Southern Pacific Railroad, a distance of 8 miles. The material is shipped to the Filtrol Company's plant in Los Angeles. The clay is used by the oil refineries in the refining of petroleum products. Ten men are employed.

*Iron Canyon Bentonite Deposit.* It comprises 20 acres, situated near the head of Iron Canyon, about one mile northeast of Sullivan Springs and 5 miles northeast of Ricardo. Elevation 3500 feet. Owner, Mrs. J. S. Bishop, Cantil, California.

A strata of clay occurs in the sandstone beds. It strikes northeast and dips  $25^{\circ}$  NW. This bed of clay is about 2 feet thick, overlain by 2 to 4 feet of sandstone. The clay is white to pink in color and is of good quality. It has been exposed by opencuts for a distance of several hundred feet. Idle.

*Koehn Clay Deposit.* It comprises 2 claims located on ridge east of Last Chance Canyon, 6 miles north of Cantil, a station on the Southern Pacific Railroad. Owner, Chas. Koehn, Gypsite.

A bed of clay, 8 to 10 feet thick, is exposed in a small gulch east of Last Chance Canyon. The bed strikes north and dips  $25^{\circ}$  W. The clay is grayish to white in color. Development consists of two tunnels about 10 feet in length. Idle.

*McKinney Clay Deposit.* It comprises 2 claims, located one-quarter of a mile east of Last Chance Canyon, about 6 miles north of Cantil, a station on the Southern Pacific Railroad. Elevation 3000 feet. Owner, Chas. McKenney, Saltdale, California.

A bed of grayish to white clay, about 12 feet thick, is overlain by andesite. It strikes north and dips  $35^{\circ}$  W. On the hanging wall of this clay strata there are 6 to 8 inches of white clay of good quality. This bed of clay is exposed by two open cuts. Idle.

*Muroc Clay Deposit.* It comprises 160 acres, situated in Secs. 2 and 3, T. 11 N, R. 9 W., S. B. M., 12 miles northeast of Muroc, a station on the Santa Fe Railroad. Owner, Muroc Clay Company; William A. Allen, president, 5525 Randolph Street, Maywood, California; William Leavins, superintendent.

The deposit occurs in a small basalt hill that rises above the floor of the valley. The bed of clay is 8 to 9 feet thick, overlain by chert, low grade clay and basalt. The stratum of clay is folded with a varying dip of about  $15^{\circ}$ . It is developed by three inclines, one on the south slope of the hill; about 500 feet east is an incline 90 feet deep and 500 feet north is another incline 185 feet deep. The material is mined in laterals run from the inclines, is hoisted and stored in loading bins, there being two bins having a capacity of 300 tons each. The clay is white in color and does not contain any foreign material. The hanging

wall is chert, with a footwall of low grade siliceous clay. The clay is loaded in trucks and hauled to Muroc for shipment to the company's plant at Maywood. Six men are employed.

*Snow White Clay Deposit.* It comprises 5 claims, known as the Snow White Group of Placer Claims, totaling 100 acres, situated in E.  $\frac{1}{2}$  of W.  $\frac{1}{2}$  of SW.  $\frac{1}{4}$  of NE.  $\frac{1}{4}$  of Sec. 30, T. 29 S., R. 32 E., M. D. M.,  $4\frac{1}{2}$  miles north of Gypsite, a siding on the Southern Pacific Railroad. Owner, O. J. Salisbury, Cantil, California. Under lease to *Los Angeles Clay Company*, Los Angeles. E. M. Brown, superintendent, Cantil, California. Elevation 3250 feet.

A large deposit of white clay has been exposed by opencuts, tunnels and shafts for a distance of about 1000 feet. This bed of clay is 50 feet thick and strikes north and dips  $30^{\circ}$  W. The clay is white in color, with occasional small, black specks included. The bed of clay is covered by an overburden of basalt of varying thickness.

The development consists of a tunnel 200 feet in length and an open-cut 150 feet in length by 50 feet in width, and 20 feet in depth. The clay is mined and hauled under contract to Gypsite for \$4 per ton. During 1926 and 1927 a large tonnage of the material was shipped to the Los Angeles Clay Company's plant located in Los Angeles. Six men are employed.

*Stevens Clay Deposit.* It comprises 4 claims situated one-quarter of a mile east of Last Chance Canyon and 8 miles north of Cantil, a station on the Southern Pacific Railroad. Elevation 2800 feet. Owner, William Stevens, Cantil, California.

The bed of clay is about 30 feet thick, overlain by an overburden of andesite several hundred feet thick. The color of the clay is grayish to white. Development consists of two tunnels 20 feet in length. Idle.

*Staats and Mahood Bentonite Deposit.* Dave Staats and J. S. Mahood of Randsburg own a deposit of bentonite near Tracy, a siding on the Southern Pacific Railroad, about 19 miles north of Randsburg. The clay is reported to be of good quality. Idle.

*White Bluff Clay Deposit.* It comprises 2 claims located on the same belt of clay as that worked by the Los Angeles Clay Company. The deposit is situated on the ridge west of Last Chance Canyon, about  $1\frac{1}{2}$  miles south of Cudahy Camp and 6 miles north of Gypsite. Elevation 3400 feet.

The bed of clay is about 20 feet thick, covered with an overburden of basalt, which varies from 50 to 100 feet in thickness. The clay is white in color. Inclosed in this white clay are small, black to greenish-black pebbles. The material is of good quality and the possibilities appear favorable for development of a large tonnage. Development consists of two crosscut tunnels, each 20 feet in length. Idle.

*White Swan Clay Deposit.* It comprises two claims, situated in Sec. 14, T. 30 S., R. 26 E., M. D. M., on the north side of Jawbone Canyon and 8 miles northwest of Cantil, a station on the Southern Pacific Railroad. Owners, Ray Young and Frank Miller, Mojave, California.

Two parallel strata of clay strike N.  $30^{\circ}$  E., dipping  $40^{\circ}$  NW. The beds of clay are 8 to 20 feet thick, with an overburden of andesite. It has been exposed by a number of shallow opencuts at intervals along the outcrop. The clay is white in color and of good quality.



## GYPSUM.

Deposits of gypsum occur along the lower foothills of the Sierra Nevada Mountains in Kern County, extending from Caliente in the south to the boundary line of Kern and Tulare counties on the north. Commercial deposits of gypsum have been developed in the valley of Cottonwood Creek, 5 miles north of Pampas, a station on the Southern Pacific Railroad. The beds of gypsum in this area are very extensive. The gypsum occurs both as a crust on the surface and as interstratified beds. The latter vary from 20 inches to 5 feet and lie upon a bed of marl. The material was formerly mined and used for fertilizing purposes. In Secs. 21, 27, 28 and 29, T. 29 S., R. 30 E., M. D. M., on both sides of Cottonwood Creek, are deposits of gypsum that were formerly mined.

Commercial deposits of gypsum occur near McKittrick in Sec. 21, T. 30 S., R. 22 E., M. D. M., and in Sec. 30, T. 30 S., R. 22 E., M. D. M., about 3 miles southeast of McKittrick.

There are several small areas in the vicinity of Sunset that carry thin deposits of gypsite. Large quantities of gypsite occur in eastern Kern County near Gypsite, a station on the Owenyo branch of the Southern Pacific Railroad. The only producer is the Mojave Desert Gypsum Deposit operated by G. W. Abel, Cantil, California.

Bibl: State Mineralogist's Reports X, p. 223; XI, p. 233; XII, p. 324; XIV, pp. 515-516; U. S. G. S. 413, pp. 16-20.

*Mojave Desert Gypsum Deposit.* It comprises 420 acres located on the southern extremity of Dry Salt Lake, southeast of Saltdale. Owner, Chas. Keohn, Cantil, California. Under lease to George W. Abel, Cantil, California. Elevation 2000 feet.

The gypsum deposits are in the lake bed. This lake bed is of a type common in the Mojave Desert and is a number of miles in extent. The surface soil is salty so that almost no vegetation grows on it except salt grass. The lake receives draining from the mountains both on the east and west, but it is rarely that sufficient rain falls in the mountains to furnish the streams enough water to cover the surface of the dry lake bed. The gypsum is found to a depth of 9 to 12 feet, underlain by a bed of clay. In many places the gypsum nearest the surface is rather dirty, while below that is a stratum 14 inches to 2 feet thick of clean white, granular gypsum. In places the gypsum is cemented into a clean, spongy mass. At other places, the gypsum crystals reach an inch or more in breadth but are thin in proportion.

The method of working is as follows: The deposit is first plowed and the salt grass removed by scrapers. The material is then delivered by scrapers to loading pockets, from which it is dumped into a train of ten cars and hauled by Plymouth locomotive to the plant a distance of  $2\frac{1}{2}$  miles. The crude gypsum is dumped at ground storage near the plant. From this ground storage it is transported by scrapers to a hopper, from which it is fed to a Williams mill, driven by 30-h.p. motor; then the product from the Williams mill is elevated by bucket elevator to storage bins; from these bins it goes to sacking machines. The plant has a capacity of 100 tons per day. The products sold consist of 150 tons of crude gypsum and 100 tons of ground gypsum. The yearly output is about 10,000 tons. The material is sold for fertilizing purposes. Twelve men are employed.



*Analysis by Edward S. Babcock and Sons, Riverside, California.*

	<i>Per cent</i>
Insoluble Residue -----	9.70
Calcium Oxide (CaO) -----	29.23
Magnesium Oxide (MgO) -----	1.03
Carbon Dioxide (CO <sub>2</sub> ) -----	1.43
Chloride (Cl) -----	0.23
Sulphur Trioxide (SO <sub>3</sub> ) -----	40.82
Water of Crystallization -----	17.50
Gypsum -----	83.60

#### LIME AND LIMESTONE

Deposits of limestone occur at many points throughout Kern County. The principal known deposits of any extent occur in the following districts: Along Erskine Creek, about 5 miles south of Isabella; north of Mojave, about 3 miles west of Cinco; along Cuddy Canyon, 8 miles west of Lebec; the most extensive deposits being located in the Tehachapi Range near the town of Tehachapi.

The lime industry is a large and important one at Tehachapi, on the Southern Pacific Railroad. The limestone deposits formerly operated by the *Jameson Lime Company*, which are located 2 miles east of Tehachapi, are now used in the manufacture of cement at Monolith by the Monolith Cement Company.

*Cuddy Canyon Limestone Deposit.* It comprises three claims situated in T. 8 N., R. 20 W., M. D. M., about 8 miles west of Lebec, on the Ridge Route. Elevation 5300 feet. Owner, Henry Kramer, La Crescenta, California.

A massive belt of limestone is exposed on a ridge northeast of Cuddy Canyon. The general strike of this belt of limestone is northwest, with a dip to the northeast. The limestone is exposed for a distance of 4500 feet in length and about 300 feet in width. It is a white, crystalline limestone. Analysis of samples taken show 96% CaCO<sub>3</sub>. Idle.

*Erskine Creek Limestone Deposit.* A large deposit of limestone occurs along Erskine Creek, some 30 miles north of Caliente and 6 to 8 miles south of Isabella.

*Isabella Limestone Deposit.* There is a belt of limestone about 4 miles east of Isabella on the Isabella-Weldon road. This belt of limestone has a general north and south course and evidently cuts across South Fork Valley as it outcrops again southeast of Kernville. The belt of limestone is 300 to 600 feet wide and can be followed along its outcrop for a number of miles.

*Monolith Portland Cement Company.* Coy Burnett, president; Wilmar Evans, vice-president and general manager; J. J. Calkins, secretary. Offices, 1308 A. G. Bartlett Building, Los Angeles. M. A. Garrison, plant superintendent.

The cement plant is a 4000-barrel wet-process plant, using limestone and clay for raw materials, located at Monolith, a station on the Southern Pacific Railroad, about 8 miles southeast of Tehachapi. The plant has a silo storage capacity of 160,000 barrels.

*Limestone Deposit.* The limestone deposit is situated in Sec. 14, T. 32 S., R. 33 E., M. D. M., about 2 miles east of Tehachapi, and 4 miles by road north of Monolith. Holdings comprise 320 acres.

The limestone is in part, coarsely crystalline and blue to white in color. The belt is at least 2500 feet wide and several hundred feet thick, with only a light soil overburden. The quarry is located on the west slope of the limestone hill and the face of the quarry is 1500 feet in length by several hundred feet high.

The broken material in the quarry is loaded by one Lorain electric shovel, bucket capacity being  $1\frac{1}{4}$ -cu. yd. and one Erie steam shovel into two trains of 10 side-dump cars. The train is hauled by 20-ton Plymouth locomotive to the crushing plant. The capacity of side-dump cars is  $5\frac{1}{2}$  tons each. In eight hours 1600 tons of rock is delivered to the crushing plant.

**Crushing Plant.** The capacity of the crushing plant is 1300 tons. The material from quarry is dumped on an oscillating grizzly 15 feet long by 6 feet wide, openings being 5 inches; oversize from grizzly is fed directly into 48" x 60" Traylor jaw crusher driven by 100-h.p. motor. The minus 5" material is elevated to a revolving screen where fines are cut out; oversize from screen goes to 48" Williams mill, driven by 100-h.p. motor; the product from Williams mill is conveyed by 30" belt conveyor to storage bins having a capacity of 850 tons; the crushed material from storage bins is loaded into cars having a capacity of 12 tons each; two trains of 12 cars each are hauled by Vulcan locomotives, a distance of 5 miles to the cement plant at Monolith. The clay to mix with the limestone for the manufacture of cement, is secured from open pits 4 miles northeast of Monolith. The clay is loaded by electric shovel into a train of 12 cars, the capacity of cars being 12 tons each. The trains of clay and limestone are delivered to an automatic car dumper which dumps it into a bin; the material from the bin is conveyed by 30-inch belt conveyor to storage bins having a capacity of 48 hours run of clay and limestone; the limestone and clay are elevated to separate hoppers. From these individual hoppers it goes onto belt conveyors, to automatic weighers where the proportion of clay and limestone by weight are mixed.

**Grinding Mill.** It consists of 4 Worthington tube mills 7 feet in diameter by 26 feet long. Each mill is driven by a 600-h.p. General Electric Company super-synchronous motor. The clay and limestone rock are ground by the four mills; the slurry, which is 35% water, from four Worthington mills goes to two sump tanks; the slurry is pumped by two 3" Wilfley pumps to 6 slurry storage tanks; these tanks have a combined capacity of 800 barrels of cement; the material from these storage tanks is discharged into three correction tanks; the corrected and mixed slurry are transferred by Wilfley pumps to storage basin.

**Kiln House.** The four kilns are of Traylor Engineering Company make and are 11 feet in diameter and 215 feet long; fired by natural gas. The cement clinker from each kiln falls on drag-chain conveyors which discharge it onto a conveyor which extends under storage shed to a vertical bucket elevator in mill room; the clinker bucket elevator delivers to hoppers over the finishing mills. Excess clinker is conveyed to ground storage.

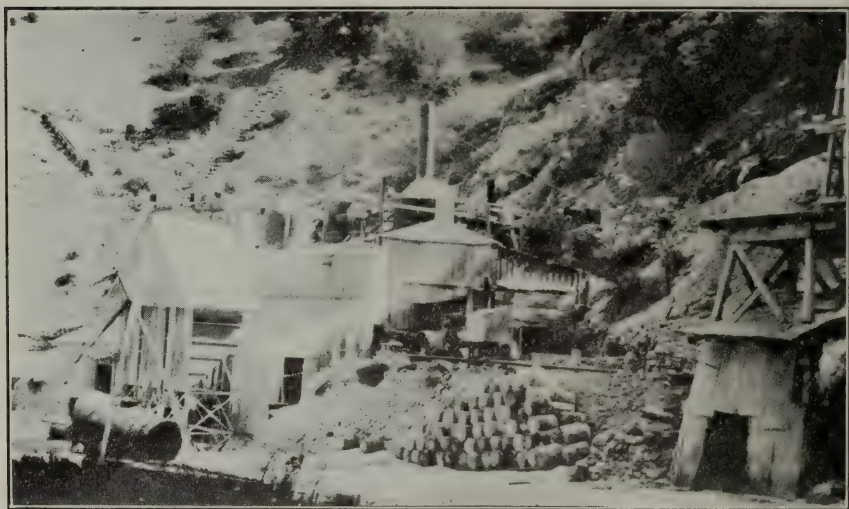
**Finishing Mills.** For grinding clinker there are two Krupp mills and 9 Allis-Chalmers 4' x 8' ball mills. The clinker is ground in these mills. Finished cement is delivered to silos having a capacity of 160,000

barrels. The packhouse joins the silos. It is equipped with Bates sacking machines and Bates tying machine. Two hundred and sixty men are employed.

*Mountain Summit Limestone Deposit.* The deposit is situated 8 miles northwest of Tehachapi, near Keene, a station on the Southern Pacific Railroad. The deposit was operated a number of years by the Mountain Summit Lime Company, of Los Angeles. Idle.

*Tardy Limestone Deposit.* It is situated 3 miles west of Cinco. The belt of limestone strikes northwest and southeast. Owner, Jack Tardy, Los Angeles.

*Union Lime Company.* F. O. Wyman, president; E. B. Wyman, secretary and general manager. Offices, 3220 San Fernando Road, Los Angeles. L. H. Warsap, plant superintendent. Holdings of the com-



Lime kilns. Union Lime Company. Tehachapi, Kern County.

pany comprise 1720 acres of patented land in Sec. 35, T. 12 N., R. 15 W., S. B. M., about 3 miles south of Tehachapi.

The limestone occurs in heavy beds, with a strike of N. 75° W. and dips to the north, varying in color from white to light blue. It is all crystalized, in some places coarse-grained and elsewhere fine-grained. The belt of limestone is about 4000 feet in length and about 500 feet thick, interbedded with schist. Three quarries have been opened up along this line of limestone at different elevations. At present writing they are working the upper quarry. Broken material from quarry is handled by a system of incline tramways; rock from quarry is delivered over surface tramway to four kilns, each kiln having a capacity of 8 tons; the kilns are fired with natural gas; forty-five tons of sorted rock is delivered to the kilns per 8-hour shift. The limestone is slated to run 98.5%  $\text{CaCO}_3$  and 2%  $\text{SiO}_2$ . The burned lime is crushed and screened making three sizes, from 2" to fines. The burnt lime is hauled by truck to hydrator plant at Tehachapi.



The hydrator plant is operated nine hours per day and has a capacity of 8 to 9 tons of hydrated lime per nine-hour day. Products produced are: Bulk lime and hydrated lime. The lime is marketed under the trade name of Blue Summit Lime. Fifteen men are employed.

Bibl: State Mineralogist's Reports XIII, p. 628; XIV, pp. 518, 519; Bull. 38, p. 71.

#### MARBLE

Marble occurs near Neenach, on the south slope of the Tehachapi Range, in Brights Valley, in San Emigdio Canyon and along Erskine Creek. The Neenach deposit is the only one that has been worked.

*Antelope Valley Marble Quarry.* It is situated in Sec. 2, T. 9 N., R. 17 W., S. B. M., near Neenach, on the south slope of the Tehachapi Range. The deposit consists of a large body of fine-grained marble, consisting of beds of various colors, dipping at an angle of  $35^{\circ}$  into the mountain. The marble is white in color, with reddish-brown and heavy, blue veins. Idle.

Bible: State Mineralogist's Reports VI, part 1, p. 23; XIII, p. 629; XIV, p. 520; Bull. 38, p. 100.

#### MAGNESITE

*Bissell Magnesite Deposit.* It is situated  $1\frac{1}{2}$  miles north of Bissell, a station on the Santa Fe Railroad and 11 miles southeast of Mojave. Holdings comprise 40 acres.

It is said to be the only occurrence of magnesite of sedimentary origin in the United States. The magnesite occurs in beds interstratified with clay and clay shales, the whole having a width of 300 feet and can be traced for a distance of 2500 feet. The general strike of the beds is east and west, dipping  $29^{\circ}$  S. The magnesite strata vary from mere seams up to 4 feet thick.

The deposit was worked in 1917 by the International Magnesite Company, Pasadena, California. During this period about 500 tons of magnesite was shipped to the company's plant at San Diego.

#### Analysis

	Per cent
Silica $\text{SiO}_2$ .....	6.03
Aluminum and iron oxide $\text{Al}_2\text{O}_3$ and $\text{Fe}_2\text{O}_3$ .....	1.40
Lime $\text{CaO}$ .....	1.56
Magnesia $\text{MgO}$ .....	42.78
Carbon Dioxide $\text{CO}_2$ .....	45.78
Undetermined .....	2.45

Bibl: State Mineralogist's Reports XVII, pp. 312-313; XIV, pp. 519-520; Bull. 540, U. S. G. S., pp. 512-516.

#### MINERAL SPRINGS

Kern County has a number of mineral springs, especially along the Kern River.

Bibl: Water Supply Paper No. 338, U. S. Geol. Survey.

*Air Compressor Springs*, also known as *Hobo*, consists of three springs on the Kern River in Sec. 15, T. 27 S., R. 32 E., M.D.M., about

3 miles west of Isabella. The waters contain sulphuretted hydrogen; temperature 140° F.; camping place for people during the summer months.

Bibl: State Mineralogist's Report XIV, p. 520; Water Supply Paper No. 338, U. S. Geol. Survey.

*Delonagha Hot Springs.* It consists of three springs in Sec. 26, T. 27 S., R. 31 E., M.D.M., about 34 miles north of Caliente, at an elevation of 2500 feet. Water contains iron, sodium and other salts; temperature 116° F.

Bibl: State Mineralogist's Report XIV, p. 520.

*Democrat Hot Springs.* It comprises 5 springs situated in Sec. 5, T. 28 S., R. 31 E., M.D.M., 28 miles north of Bakersfield, on the south bank of Kern River. Owner, Mrs. Anna Moberg, Bakersfield, California.

The water contains iron, sodium and other salts; temperature 115° F. Analysis by George A. Colby, chemist, Berkeley, California.

	<i>Parts per million</i>
Sodium sulphate (Glauber's salt) -----	11.5
Sodium chloride -----	160.0
Sodium carbonate -----	42.4
Calcium and magnesium carbonates -----	30.0
Calcium sulphate -----	nil
Silica -----	60.0
Volatile -----	60.0

Hotel, cottages, bathhouse and swimming pool.

*Kernville Hot Springs.* It consists of 2 springs situated in Sec. 34, T. 25 S., R. 33 E., M.D.M., on the Kern River, 2 miles northeast of Kernville, at an elevation of 2700 feet. Owner, A. Brown and Company, Kernville, California.

The water contains iron and sodium salts; temperature 100° F.

*Koehn Springs,* consist of 5 springs located on the Koehn Ranch near Gypsite, in Sec. 8, T. 30 S., R. 30 E., M.D.M., about 15 miles west of Randsburg. Water contains borax and other salts; temperature 80° F. Owner, Chas. Koehn, Cantil, California.

*Neill's Hot Springs.* There are 3 springs located in Sec. 31, T. 26 S., R. 33 E., M.D.M., about 3 miles north of Isabella, at an elevation of 2500 feet. Owner, James Neill, Isabella, California. Water contains iron, sodium chloride and other salts; temperature 130° F.; accommodations for a few guests, with baths.

*Werringer Sulphur Springs* consists of 6 springs in Sec. 3, T. 26 S., R. 29 E., M.D.M., about three-quarters of a mile south of Woody, at an elevation of 1600 feet. Owner, J. Werringer, Woody, California. Accommodations for a few guests.

*Willow Springs* consist of 23 springs in Sec. 13, T. 9 N., R. 13 W., S.B.M., about 3 miles west of Rosamond, at an elevation of 2600 feet. Owner, E. M. Hamilton Estate. Water contains sodium chloride, borates and other salts.

## ONYX

*Bert Ray* owns a deposit of onyx situated near Onyx, east of Kernville. Undeveloped.

## ROSE QUARTZ

*James W. Stockton*, Bakersfield, California, owns a deposit of rose quartz, situated in the Greenhorn Mountains, north of Kernville. Undeveloped.



Cudahy Silica Deposit.  
Last Chance Canyon, Gypsite, Kern County.

## PETROLEUM AND NATURAL GAS

Kern County ranks second to Los Angeles County in the production of petroleum and natural gas. The production of petroleum for the year, 1926, amounted to 54,549,646 barrels, valued at \$78,987,887. The



production of natural gas in 1926 amounted to 44,182,140 M. cu. ft., valued at \$2,158,867.

Bibl: Bulletins 69, 73, 82, 84 and 89; Reports of Oil and Gas Supervisor, 1915 to date.

#### SANDSTONE

A large quantity of sandstone is found a few miles south of Tehachapi and in San Emigdio Canyon. A large deposit occurs in Sec. 14, T. 32 S., R. 34 E., M.D.M., 6 miles south of Tehachapi and three miles from Erie, a station on the Southern Pacific Railroad. The sandstone is a bedded deposit and varies in thickness from 3 to 30 feet. The colors are green, blue, red, tan and drab.

Bibl: Bull. 38, pp. 128 and 370; State Mineralogist's Report XIV, p. 522.

#### SULPHUR

Small deposits of sulphur occur in the western part of Kern County in the Sunset Oil District.

Bibl: Bull. 3, p. 33; Bull. 38, p. 372; State Mineralogist's Reports XI, p. 233; XII, p. 410; XIV, p. 522.

#### VOLCANIC ASH (SILICA)

*Cudahy Silica Deposit.* It comprises 160 acres situated in Last Chance Canyon, 8 miles north of Gypsite, a station on the Southern Pacific Railroad. Elevation 3200 feet. Owner, Cudahy Packing Company, Los Angeles.

The bed of volcanic ash is 8 to 9 feet thick and strikes N. 30° E., dipping 15° NW. It is overlain by sandstone. The strata lie about 500 feet above the floor of the canyon. The material mined is delivered to incline tramway over which it is transported to loading bins. The tramway is 475 feet in length and the capacity of the cars is 1½ tons. The material from loading bins is hauled by trucks to Ceneda Siding, on the railroad near Gypsite. The output amounts to about 100 tons per week. The silica is used for the manufacture of Dutch Cleanser. Twelve men are employed.

*Parrot and Allec Silica Deposit.* It is situated 3 miles south of the Cudahy Silica Deposit, on the west side of Iron Canyon and is 6 miles north of Gypsite, a station on the Southern Pacific Railroad. There are 6 claims. Elevation 3256 feet. Owners, William Parrott and Allec, Cantil, California.

The beds of silica strike N. 30° E. and dip 25° W. The white silica is 8 feet thick, with 20 feet of gray silica on the footwall. This belt of volcanic ash can be followed along its outcrop for a distance of 9000 feet. It has been developed at intervals along this distance by short tunnels and opencuts. The beds of silica are overlain by sandstone. It is reported that 50 tons of the white silica was shipped to Los Angeles in 1926. The material is employed in making soap and cleanser compounds. Idle.

## SALINES

Under this heading are included borax, common salt, soda, potash and other alkaline salts. The first two were produced during recent years in Kern County. The main resources of the salines are the lake beds of the desert regions of Kern County. The latest development in the borax industry is the finding in quantity and the opening up



Parrot and Allec Silica Deposit.  
Iron Canyon, Ricardo.

of a new borate mineral which has supplanted colemanite (calcium borate) in much the same way that the colemanite deposits displaced the borax industry in the desert playas or dry lakes some forty years ago. This new mineral is kernite (or rasorite<sup>1</sup>), a sodium borate, with a

<sup>1</sup> This new mineral is called by both names in the Kramer district.

smaller water-of-crystalization content than the 'borax' of commerce, so that when recrystallized to borax, the resulting product has an increased weight over the original material. These deposits are situated in T. 11 N., R. 7 and 8 W., S. B. M., in southeastern Kern County, and are being developed by the Pacific Coast Borax Company and the Western Borax Company.

The first discovery of borax in this area was made by Dr. John K. Sukow, in 1912; in sinking a well for water in Sec. 14, T. 11 N., R. 8 W., he discovered colemanite. The Pacific Coast Borax Company purchased the property and prospected the ground with a number of drill holes and although colemanite was found it was not of sufficient extent to warrant further exploration and interest in the discovery of borate in this area died out until 1925. In the spring of 1925, William M. Dowsing and John L. Hannam, who had located a number of claims in this area, sunk their first drill hole in the NE.  $\frac{1}{4}$  of Sec. 24, T. 11 N.,



Headframe and plant. Pacific Coast Borax Company. Borate, Kern County.

R. 8 W., and encountered the new borate mineral, kernite, at 285 feet, passing through 10 feet of colemanite and kernite; then passed through 15 feet of blue shale impregnated with colemanite; at 312 feet cut main body of kernite which was 122 feet thick. At 434 feet the hole entered blue shale and at a depth of 500 feet encountered basalt. Five holes were drilled along the northern line of Sec. 24, all of which encountered the orebody of kernite at 325 feet. W. M. Dowsing and John L. Hannam sold their holdings to the Pacific Coast Borax Company in January, 1926. This company has been active in the development of the new borate field to date. The discovery of this new mineral has caused the company to suspend operations on their colemanite properties in Inyo County.

*Pacific Coast Borax Company.* R. C. Baker, president; C. B. Zebriskie, vice-president and general manager; W. F. Wemphal, secretary; C. M. Rasor, manager. Local offices, Central Building, Los



Angeles. The holdings of the company comprise about 4000 acres, situated in T. 11 N., R. 7 and 8 W., S. B. M., north of Rich, a station on the Santa Fe Railroad.

The borate-bearing strata have been proven by drill holes to be four miles in length from east to west and about  $1\frac{1}{2}$  miles in width from north to south. The trend of the deposit has not been definitely determined but it appears to strike east and west. The high grade kernite appears to be in the center of the borate-bearingbeds, with a possible strike of northwest to southeast.

The development consists of three vertical shafts, two of which are located in Sec. 24, T. 11 N., R. 8 W. and are single compartment shafts 470 feet deep. The main working shaft is located in Sec. 19, T. 11 N., R. 7 W. The main shaft is sunk to a vertical depth of 500 feet and consists of two hoisting compartments and manway. This shaft cut the orebody at a depth of 400 feet. Levels have been driven at 415, 455 and 485 feet. The development work on these levels consists of over two miles of drifts and crossouts. The orebody is said to be proven for 1500 feet north and south and about 1200 feet east and west. The thickness of the borate strata varies from 85 to 114 feet. The hanging and footwall are a gray shale. The strata in places show some folding and it appears to have a slight dip to the southwest. The drifts and crossouts are run 8 feet high by 20 feet wide without requiring any timber. The ore is hoisted by 75-h.p. electric-driven double-drum hoist in steel skips, which have a capacity of  $1\frac{1}{4}$  tons per skip. The ore is dumped into storage bins in steel head frame that has a capacity of 300 tons. The ore from bins in headframe is conveyed by belt conveyor to 13" Allis-Chalmers McCully gyratory crusher, driven by 50-h.p. motor. It is crushed to pass a 2" ring. The product from crusher is elevated by bucket elevator to link belt screen; the oversize goes directly into Symonds cone type of crusher where it is crushed to 1-inch square mesh. The minus 1-inch product from screen and cone crusher join on conveyor, then are elevated to two steel storage bins, each of which has a capacity of 150 tons; one bin being for low grade material, the other being for high grade kernite. The material from high grade bin is sacked with Bates sacking machine and loaded directly in railroad cars for foreign shipment. The low grade material is bulk loaded into cars for shipment to the company's refinery at Wilmington. The company is at present installing four rotary kilns for calcining the material and is also planning to concentrate the low grade material with Stebbins dry concentrators. The total horse power required to operate the plant is 1000 horse power. Electric power is secured from the Southern Sierras Power Company. The capacity of the plant will vary from 5000 to 10,000 tons per month. Fifty men are employed.

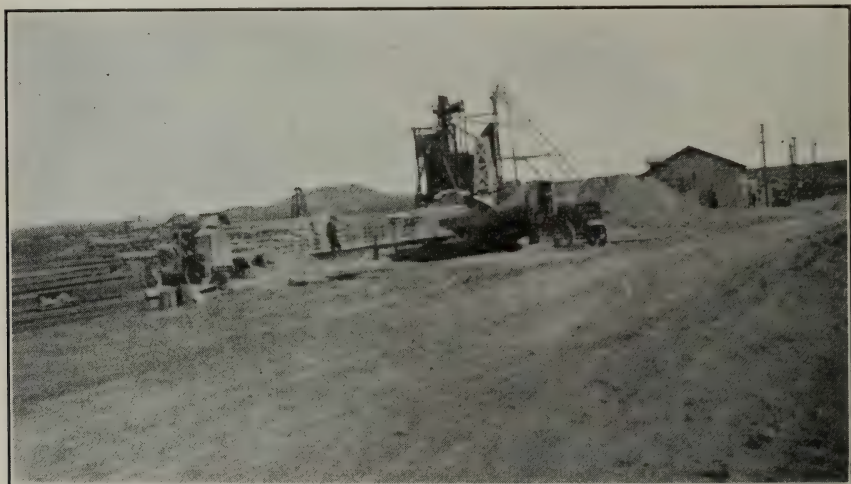
*Sukow Borax Mine.* It is situated in Sec. 14, T. 11 N., R. 8 W., S. B. M., about one mile northwest of the Pacific Coast Borax Company's plant and 4 miles north of Rich, a station on the Santa Fe Railroad. Elevation 2600 feet. Owner, Sukow Chemical Company; Dr. John K. Sukow, president, 3215 East Twentieth Street, Los Angeles; T. R. Hughes, superintendent.

Development consists of three shafts, 125, 300 and 485 feet deep. The main working shaft is 485 feet deep and a colemanite orebody was cut

at a depth of 310 feet. The orebody is said to trend northwest and southeast, with a slight dip to the northeast and to be 70 feet thick. The principal development work is on 380-foot level, the total amount of drifts being 1000 feet. Material from dump is being hauled in trucks to a calcining plant having a capacity of 25 tons per 24 hours. Six men are employed.

*Western Borax Mine.* It is situated in S $\frac{1}{2}$  of Sec. 24, T. 11 N., R. 8 W., S. B. M., north of Rich, a station on the Santa Fe Railroad. Elevation 7500 feet. Owner, Western Borax Company; A. M. Buley, president; Henry Blumenberg, vice-president and general manager; W. M. Balling, superintendent. Offices, 566 Subway Terminal Building, Los Angeles.

The company has developed two strata of kernite ore by means of drill holes and a vertical shaft 890 feet deep. The orebody strikes northeast and southwest and dips 15° NW. The principal development



Western Borax Mine. Western Borax Company. Borate, Kern County.

work has been confined to the 850-foot level, total amount of drifts being 1000 feet. The orebody on this level has a width of 160 feet and has been developed for 200 feet along its strike. It is 40 feet thick and between this orebody is 15 feet of gray shale above which is another orebody about 35 feet thick. Ore from 850-foot level is hoisted by single-drum electric-driven hoist, driven by 75-h.p. motor. The ore skip has a capacity of 2 tons and is dumped into an 80-ton storage bin. From bin the material is fed to Sturdevant rotary fine grinder. This crusher has a capacity 100 tons per 24 hours. The ore is ground to one-inch size; the product from crusher is elevated by bucket elevator to storage hopper of 35 tons capacity; then sacked by sacking machine. The sacks weigh 250 pounds each. The sacked material is stored in a warehouse 250 feet in length by 50 feet in width. The production is 2500 tons per month. The product is being shipped to Germany. First shipment was made from the property on November 27, 1927. Thirty-five men are employed.

## SALT

*Consolidated Salt Company.* F. G. Fenton, president; E. H. Ward, secretary and manager, Long Beach California; H. C. Topp, plant superintendent.

The deposit of salt occurs on a large dry salt lake southeast of Salt-dale, a station on the Southern Pacific Railroad. Elevation 1950 feet.

The salt in the brines of the lake is recovered by solar evaporation. The water for the vats on the lake is brought in by a ditch line one mile in length from the east side of the lake. The Fremont vats, which are located on the northeast end of the lake, consist of two vats, one of 8 acres in extent, the other being 4 acres. Water from the ditch line is pumped into vats by an 8" Byron-Jackson centrifugal pump, driven by 25-h.p. Hercules gas engine. The crop of salt recovered from these vats is 6 to 8 inches thick. To the southeast of the Fremont vats are the Consolidated vats which cover 70 acres. The vats are 40 to 44 inches in depth. The pumping plant is located in the center of this vat area and is arranged to distribute the water in three different directions. The pumping plant comprises two centrifugal pumps, one of 8 inches, the other of 10 inches, driven by two 25-h.p. motors. Water for pumping plant is supplied by 2½ miles of ditch 6 feet in depth by 30 feet in width. Additional water is secured from a well 140 feet deep. The salt recovered in vats is harvested by hand and loaded into cars having a capacity of 1¼ tons. A 20-ton Plymouth locomotive hauls a train of 8 cars to the plant, a distance of 1½ miles. The salt is dumped into hopper at plant from which it is fed to roll type of crusher. The product from crusher is elevated by bucket elevator to revolving screens where it is screened to ⅜", ¼" and ½" sizes. From the screens it goes over a belt conveyor to storage bins. The products are shipped in bulk to the plant of the *Long Beach Salt Company, Long Beach, California*. The capacity of the plant is 150 tons per day. The yearly production varies from 15,000 to 20,000 tons, depending on the amount of rain during the year. The cost of harvesting, milling and loading on railroad cars is \$1 per ton. Seven men are employed.





## OIL FIELD DEVELOPMENT OPERATIONS

By R. D. BUSH, State Oil and Gas Supervisor

From October 1, 1928, to and including December 31, 1928, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
<b>COLUSA COUNTY:</b>					
H. Allen Rispin.....	20	13	3	1	
<b>FRESNO COUNTY:</b>					
Bullion Mining Co.....	20	19	15	2	Coalinga
Cates Allen No. 1.....	7	19	15	1	Coalinga
Currency Petroleum.....	28	21	14	1	
George F. Getty, Inc.....	4	22	17	Armstrong 1	
<b>KERN COUNTY:</b>					
Berry Oil Co.....	30	28	21	89	Belridge
Berry Oil Co.....	30	28	21	93	Belridge
Berry Oil Co.....	30	28	21	95	Belridge
Berry Oil Co.....	30	28	21	231	Belridge
Berry Oil Co.....	30	28	21	232	Belridge
The Ohio Oil Co.....	30	28	21	20	Belridge
The Ohio Oil Co.....	30	28	21	21	Belridge
The Ohio Oil Co.....	30	28	21	22	Belridge
Union Oil Co.....	30	28	21	King 4	Belridge
Union Oil Co.....	30	28	21	King 5	Belridge
Union Oil Co.....	30	28	21	King 6	Belridge
Union Oil Co.....	30	28	21	King 7	Belridge
Associated Oil Co.....	23	28	27	24	Kern River
C. C. M. O. Co.....	23	28	27	11	Kern River
Section 26 Oil Co.....	26	28	28	1	Kern River
The Texas Co.....	14	28	27	4	Kern River
The Texas Co.....	14	28	27	5	Kern River
The Texas Co.....	14	28	27	7	Kern River
The Texas Co.....	14	28	27	8	Kern River
The Texas Co.....	14	28	27	10	Kern River
The Texas Co.....	14	28	27	11	Kern River
The Texas Co.....	23	28	27	Lehmann 8	Kern River
Franco Western Oil Co.....	8	30	22	10	McKittrick
C. C. M. O. Co.....	7	32	23	5	Midway
Cypress Petroleum Co.....	22	32	23	15	Midway
Honolulu Consolidated Oil Co.....	8	32	24	1	Midway
Honolulu Consolidated Oil Co.....	8	32	24	3	Midway
Honolulu Consolidated Oil Co.....	8	32	24	4	Midway
Honolulu Consolidated Oil Co.....	6	32	24	19	Midway
Honolulu Consolidated Oil Co.....	8	32	24	77	Midway
Italo Petroleum Corp. of America.....	26	32	23	Mt. Diablo 1	Midway
North American Oil Consolidated.....	32	31	24	21	Midway
North American Oil Consolidated.....	32	31	24	22	Midway
North American Oil Consolidated.....	32	31	24	32	Midway
North American Oil Consolidated.....	30	31	24	47	Midway
Thomas H. T. Purman.....	12	32	22	1	Midway
Republic Petroleum Co.....	7	32	23	33	Midway
Standard Oil Co.....	29	31	24	12	Midway
Standard Oil Co.....	29	31	24	14	Midway
Standard Oil Co.....	7	32	24	27	Midway
Standard Oil Co.....	9	32	24	47	Midway
Standard Oil Co.....	7	32	24	61	Midway
Standard Oil Co.....	29	31	24	91	Midway
Standard Oil Co.....	29	31	24	92	Midway
Standard Oil Co.....	36	31	23	McNee 64	Midway
A. Bruce Frame.....	28	26	28	Domion 2	Mt. Poso
General Petroleum Corp.....	21	27	28	Glide 21 6	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 4	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 5	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 6	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 7	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 8	Mt. Poso
Petroleum Securities Co.....	15	27	28	Glide-Vedder 2	Mt. Poso

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>KERN COUNTY—Continued.</b>					
Shell Co.....	16	27	28	Security 1	Mt. Poso
Shell Co.....	16	27	28	Security 2	Mt. Poso
Shell Co.....	16	27	28	Security 4	Mt. Poso
Signal Oil and Gas Co.....	27	27	28	4-A	Mt. Poso
Signal Oil and Gas Co.....	14	27	27	Fitzhugh 1	Mt. Poso
Signal Oil and Gas Co.....	14	27	27	Signal McVan 1	Mt. Poso
The Texas Co.....	15	27	28	Glide 2 4	Mt. Poso
Elbe Oil Land Development Co.....	20	28	29	Freeman 2	Round Mountain
The Kern River Oilfields of California, Ltd.....	13	28	28	Kernco 3	Round Mountain
Signal Oil and Gas Co.....	8	11	23	2	Sunset
Charles A. Son.....	8	11	23	3	Sunset
Elmer Co.....	2	29	20	1	Temblor
K. C. Wallace.....	32	29	21	1	Temblor
Standard Oil Co.....	28	11	20	Kern County Lease No. 2 36	Wheeler Ridge
Clar-Kel Oil Corp.....	19	27	29	1	
General Petroleum Corp.....	5	30	29	Seale 5 10	
Gerard and Phillips.....	32	27	29	1	
George F. Getty, Inc.....	21	29	27	Farrell 1	
Lincoln Drilling Co.....	6	28	23	1	
Andrew Lucas.....	21	29	27	1	
Alfred L. Marsten.....	27	29	27	2	
The Pacific Eastern Production Co....	22	29	27	6-KCL-B	
The Pacific Eastern Production Co....	22	29	27	7-KCL-B	
The Pacific Eastern Production Co....	22	29	27	Martin 1	
Constance V. L. Perry.....	34	26	26	De Villiers 1	
Richfield Oil Co.....	36	27	23	Redding 1	
Standard Oil Co.....	24	29	27	Kern County Lease No. 5 2	
Superior Oil Co.....	19	26	28	Glide 1	
Symark Oil Co.....	24	29	29	1	
Union Oil Co.....	5	10	21	K. C. L. C. 1	
M. Marguerite Young.....	6	27	19	1	
<b>KINGS COUNTY:</b>					
Justice and Ellerby.....	27	19	19	1	
Milham Exploration Co.....	34	21	17	Beal 1	
Milham Exploration Co.....	2	22	17	Elliott 2	
Standard Oil Co.....	11	22	17	81	
<b>LOS ANGELES COUNTY:</b>					
Standard Oil Co.....	17	2	14	L.A.Invest. 1 58	Inglewood
Apex Petroleum Corp.....	19	4	12	Morris 13-B	Long Beach
Axis Petroleum Co.....	19	4	12	2	Long Beach
Axis Petroleum Co.....	19	4	12	3	Long Beach
Bartholomae Oil Corp.....	24	4	13	6	Long Beach
Bush and McCluskey.....	30	4	12	1	Long Beach
E. B. Campbell.....	24	4	13	5	Long Beach
Congress Petroleum Corp.....	19	4	12	1	Long Beach
Cordary-Davis Oil Co.....	24	4	13	1	Long Beach
D. M. F. Oil Co.....	24	4	13	1	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	23	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	24	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	25	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	26	Long Beach
Delaney Petroleum Corp.....	24	4	13	Anderson Comm. 1	Long Beach
Delaney Petroleum Corp.....	19	4	12	Wellington 3	Long Beach
E. L. Doheny and E. L. Doheny, Jr..	19	4	12	Nelson 1	Long Beach
E. L. Doheny and E. L. Doheny, Jr..	19	4	12	Nelson 2	Long Beach
Ganco Oil Co.....	29	4	12	3	Long Beach
General Petroleum Corp.....	13	4	13	Morris 1	Long Beach
General Petroleum Corp.....	13	4	13	Parks 1	Long Beach
Graham-Loftus Oil Corp.....	19	4	12	Bank 2	Long Beach
Graham-Loftus Oil Corp.....	19	4	12	Bank 3	Long Beach
Graham-Loftus Oil Corp.....	24	4	13	Dodge 1	Long Beach
J. C. Haggarty.....	19	4	12	5	1 1 1 1 1

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Boyd Hammond, Trustee.....	29	4	12	4	Long Beach
Hancock Oil Co.....	19	4	12	Signal 17	Long Beach
Otis Hoyt.....	19	4	12	1	Long Beach
Otis Hoyt.....	19	4	12	2	Long Beach
Magnet Oil Co.....	24	4	13	1	Long Beach
W. T. Parker.....	24	4	13	Dickey 1	Long Beach
Richfield Oil Co.....	19	4	12	Bernstein 4	Long Beach
Richfield Oil Co.....	24	4	13	Duncan 4	Long Beach
Rio Grande Oil Co.....	28	4	12	R. L. M. 2	Long Beach
Shell Co.....	29	4	12	Alamitos 37	Long Beach
Shell Co.....	29	4	12	Alamitos 38	Long Beach
Shell Co.....	29	4	12	Alamitos 39	Long Beach
Shell Co.....	29	4	12	Alamitos 8	Long Beach
Shell Co.....	29	4	12	Babb & Tucker 6	Long Beach
Shell Co.....	29	4	12	Cherry Hill Comm. 8	Long Beach
Shell Co.....	29	4	12	Goddard 7	Long Beach
Shell Co.....	29	4	12	Goddard 8	Long Beach
Shell Co.....	29	4	12	Horsch 4	Long Beach
Shell Co.....	29	4	12	Nesa 11	Long Beach
Shell Co.....	29	4	12	Nicholson 6	Long Beach
Shell Co.....	29	4	12	Nicholson 7	Long Beach
Shell Co.....	29	4	12	Nicholson 8	Long Beach
Shell Co.....	29	4	12	Pickler 11	Long Beach
Shell Co.....	24	4	13	Seepie 5	Long Beach
Signal Syn. No. 4.....	19	4	12	9	Long Beach
South Basin Oil Co.....	30	4	12	4	Long Beach
South Basin Oil Co.....	13	4	13	5	Long Beach
Southern California Drilling Co.....	29	4	12	Miller 2	Long Beach
The Teaxs Co.....	19	4	12	Fields 19	Long Beach
Traves Drilling Co.....	29	4	12	Conductor 2	Long Beach
Union Oil Co.....	19	4	12	Malin 1	Long Beach
Union Oil Co.....	24	4	13	Temple 1	Long Beach
Western Oil and Ref. Co.....	24	4	13	Noll 2	Long Beach
"We" Syndicate.....	19	4	12	1	Long Beach
Woolner Oil Corp.....	19	4	12	Signal Hill 5	Long Beach
St. Helens-Riverside Properties.....	2	2	12	Monterey 17	Montebello
Jim Pollard.....	28	2	14	Blinn 1	Potrero
Ring Exploration Co.....	28	2	14	Simons 1-A	Potrero
Union Oil Co.....	19	3	13	Rosecrans 10	Rosecrans
Union Oil Co.....	18	3	13	Rosecrans 11	Rosecrans
Ambasador Petroleum Co.....	5	3	11	S. F. 14	Sante Fe Springs
Ambassador Petroleum Co.....	5	3	11	S. F. 15	Sante Fe Springs
Associated Oil Co.....	1	3	12	Clarke 21	Sante Fe Springs
Associated Oil Co.....	6	3	11	Fulton 4	Sante Fe Springs
Bandini Petroleum Co.....	5	3	11	Off 10	Sante Fe Springs
Bandini Petroleum Co.....	5	3	11	Off 11	Sante Fe Springs
California Well Drilling Co.....	5	3	11	Roberts 2	Sante Fe Springs
Commodore Petroleum Co.....	5	3	11	Babonet 3	Sante Fe Springs
Commodore Petroleum Co.....	5	3	11	Landl 3	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 137-B	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 137-C	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 145-C	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 146-A	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 206	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 207	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 211	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 212	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 213	Sante Fe Springs
General Petroleum Corp.....	5	3	11	Sante Fe 221	Sante Fe Springs
General Petroleum Corp.....	6	3	11	Sante Fe Comm. 185-C	Sante Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 26	Sante Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 27	Sante Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 28	Sante Fe Springs
Globe Petroleum Corp.....	6	3	11	Jameson & Estle 1	Sante Fe Springs



## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
Oscar R. Howard.....	6	3	11	Hathaway 7	Sante Fe Springs
Italo Petroleum Corp. of America.....	6	3	11	Archer 1	Sante Fe Springs
Italo Petroleum Corp. of America.....	6	3	11	Archer 2	Sante Fe Springs
Italo Petroleum Corp. of America.....	6	3	11	Sante Fe	
				Brunson 1	Sante Fe Springs
Italo Petroleum Corp. of America.....	6	3	11	Sante Fe	
				Brunson 2	Sante Fe Springs
Italo Petroleum Corp. of America.....	6	3	11	Sante Fe	
				Brunson 3	Sante Fe Springs
C. C. Julian.....	6	3	11	16	Sante Fe Springs
A. L. Marsten.....	6	3	11	Hathaway 4	Sante Fe Springs
A. L. Marsten.....	6	3	11	Hathaway 5	Sante Fe Springs
McKeon Drilling Co., Inc.....	6	3	11	Sante Fe 3	Sante Fe Springs
K. G. Pulliam, Jr.....	6	3	11	1	Sante Fe Springs
Richfield Oil Co.....	1	3	12	Clarke 2	Sante Fe Springs
Richfield Oil Co.....	1	3	12	Clarke 3	Sante Fe Springs
Richfield Oil Co.....	5	3	11	Howard 3	Sante Fe Springs
Rio Grande Oil Co.....	6	3	11	Community 2	Sante Fe Springs
Rohde Investment Co.....	5	3	11	Rohde 2	Sante Fe Springs
Rohde Oil Syndicate.....	6	3	11	Rohde 1	Sante Fe Springs
Second Twin Bell Synd.....	6	3	11	5	Sante Fe Springs
Shell Co.....	31	2	11	G. H. N. 17	Sante Fe Springs
Shell Co.....	31	2	11	G. H. N. 18	Sante Fe Springs
Shell Co.....	31	2	11	G. H. N. 19	Sante Fe Springs
Shell Co.....	31	2	11	G. H. N. 20	Sante Fe Springs
Shell Co.....	31	2	11	G. H. N. 21	Sante Fe Springs
Shell Co.....	6	3	11	Slusher 16	Santa Fe Springs
Shell Co.....	6	3	11	Slusher 17	Santa Fe Springs
Shell Co.....	6	3	11	Slusher 18	Santa Fe Springs
Shell Co.....	6	3	11	Slusher B-2	Santa Fe Springs
Shell Co.....	31	2	11	Thompson 6	Santa Fe Springs
Standard Oil Co.....	31	2	11	Hepler 7	Santa Fe Springs
Standard Oil Co.....	31	2	11	Hepler 8	Santa Fe Springs
Standard Oil Co.....	1	3	12	Orr 5	Santa Fe Springs
Standard Oil Co.....	31	2	11	Santa	
				Gertrudes 12	Santa Fe Springs
Standard Oil Co.....	5	3	11	South Whittier	
				Comm. 21	Santa Fe Springs
Standard Oil Co.....	6	3	11	Walker	
				Comm. 19	Santa Fe Springs
Standard Oil Co.....	6	3	11	Walker	
				Comm. 20	Santa Fe Springs
Standard Oil Co.....	6	3	11	Weisel 18	Santa Fe Springs
Star Petroleum Co.....	6	3	11	Star 3	Santa Fe Springs
Star Petroleum Co.....	6	3	11	Star 4	Santa Fe Springs
The Texas Co.....	6	3	11	Baldwin 4	Santa Fe Springs
The Texas Co.....	6	3	11	Lamb 2	Santa Fe Springs
The Texas Co.....	6	3	11	Matern Three 15	Santa Fe Springs
The Texas Co.....	6	3	11	Matern Two 8	Santa Fe Springs
The Texas Co.....	6	3	11	Matern Two 9	Santa Fe Springs
The Texas Co.....	6	3	11	Matern Two 10	Santa Fe Springs
The Texas Co.....	31	2	11	Mutual 2	Santa Fe Springs
The Texas Co.....	6	3	11	Patterson A-14	Santa Fe Springs
The Texas Co.....	6	3	11	Patterson B-13	Santa Fe Springs
The Texas Co.....	6	3	11	Standlee 5	Santa Fe Springs
The Texas Co.....	6	3	11	Steinly 7	Santa Fe Springs
Union Oil Co.....	6	3	11	Alexander 17	Santa Fe Springs
Union Oil Co.....	31	2	11	Bell 29	Santa Fe Springs
Union Oil Co.....	6	3	11	Bell 40	Santa Fe Springs
Union Oil Co.....	31	2	11	Bell 41	Santa Fe Springs
Union Oil Co.....	6	3	11	Bell 42	Santa Fe Springs
Union Oil Co.....	5	3	11	Farwell 11	Santa Fe Springs
Universal Consolidated Oil Co.....	6	3	11	Blanchard 10	Santa Fe Springs
Universal Consolidated Oil Co.....	6	3	11	Blanchard 11	Santa Fe Springs
Universal Consolidated Oil Co.....	5	3	11	O'Connell 4	Santa Fe Springs
Universal Consolidated Oil Co.....	5	3	11	O'Connell 5	Santa Fe Springs
Wilshire Annex Oil Co.....	6	3	11	Annex Eagle 1	Santa Fe Springs
Wilshire Annex Oil Co.....	6	3	11	Annex Eagle 2	Santa Fe Springs

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>LOS ANGELES COUNTY—Cont.</b>					
Associated Oil Co.-----	11	5	12	Bryant 12	Seal Beach
Associated Oil Co.-----	11	5	12	Bryant 13	Seal Beach
Marland Oil Co.-----	11	5	12	Bixby 26	Seal Beach
Marland Oil Co.-----	11	5	12	Bixby 27	Seal Beach
Standard Oil Co.-----	3	5	12	San Gabriel 19	Seal Beach
California Eastern Oil Co.-----	32	5	17	Hasley 1	
Monterey Park Petroleum Corp.-----	25	1	12	Jepsen 1	
Richfield Oil Co.-----	13	2	13	Vernon 1	
Rio Grande Oil Co.-----	34	2	12	Osborne 1	
Smith Petroleum Co.-----	20	3	14	Durand 1	
<b>MERCED COUNTY:</b>					
John E. Faber.-----	24	6	10	2	
<b>ORANGE COUNTY:</b>					
Fullerton Oil Co.-----	2	3	10	24	Brea Olinda
Shell Co.-----	2	3	10	Orange 18	Brea Olinda
Union Oil Co.-----	2	3	10	Naranjal 14	Brea Olinda
Featherstone and Preston.-----	14	6	11	Huntington Beach 1	Huntington Beach
Rex Oil Co.-----	2	6	11	10	Huntington Beach
W. S. Van Deusen.-----	10	6	11	Van D 1	Huntington Beach
Bellport-Western Drilling and Producing Co.-----	18	6	10	Pacific 1	
The Texas Co.-----	35	4	10	Crawford 1	
<b>SAN LUIS OBISPO COUNTY:</b>					
See Canyon Oil Co.-----	18	31	12	1	
Texas Pacific Coal and Oil Co.-----	25	32	14	1	
<b>SANTA BARBARA COUNTY:</b>					
Palmer Union Oil Co.-----	30	9	32	Stendel 15	Cat Canyon
Winann Oil Co.-----	30	9	32	3	Cat Canyon
Barnsdall Oil Co.-----	15	4	29	Doty 1	Elwood
Barnsdall Oil Co.-----	15	4	29	Doty 2	Elwood
Barnsdall Oil Co.-----	15	4	29	Luton-Bell 3	Elwood
Barnsdall Oil Co.-----	15	4	29	Luton-Bell 4	Elwood
Barnsdall Oil Co.-----	15	4	29	Luton-Bell 5	Elwood
Cady Oil Co.-----	23	4	29	Bishop 1	Elwood
E. L. Doheny and E. L. Doheny, Jr.-----	18	4	28	Storke 1	Elwood
Ted Martin.-----	4	4	28	1	Elwood
J. E. O'Connell.-----	23	4	29	Campbell 1	Elwood
Rice Ranch Oil Co.-----	23	9	34	Brookshire 11	Santa Maria
Bankline Oil Co.-----	4	4	27	Ducan Ranch 1	
Continental Oil Co.-----	4	4	25	Franklin 1	
Shell Co.-----	6	4	30	Rutherford 1	
Standard Oil Co.-----	7	4	35	Rose-Shyvers 1	
<b>SANTA CLARA COUNTY:</b>					
Carl Crossen.-----	9	8	1	1	
<b>SONOMA COUNTY:</b>					
Shell Co.-----	5	6		Doss 1	
<b>STANISLAUS COUNTY:</b>					
J. G. Tavares.-----	30	7	8	1	
<b>TULARE COUNTY:</b>					
Angiola Oil Co.-----	27	22	23	1	
<b>VENTURA COUNTY:</b>					
C. C. M. O. Co.-----	17	3	24	Hobson B-5	Rincon
C. C. M. O. Co.-----	17	3	24	Hobson B-6	Rincon
Shell Co.-----	31	3	17	Marr 1	Simi
Ohio Oil Co.-----	32	3	21	1	South Mountain
Union Oil Co.-----	13	3	21	Crane 4	South Mountain
Associated Oil Co.-----	22	3	23	Hartman 9	Ventura
Associated Oil Co.-----	22	3	23	Hartman 12-A	Ventura

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY—Continued.					
Associated Oil Co.-----	22	3	23	Hartman 17	Ventura
Associated Oil Co.-----	22	3	23	Hartman 19	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 59	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 65	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 67	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 71	Ventura
Associated Oil Co.-----	23	3	23	McGonigle 5	Ventura
California Ventura Oil Co.-----	33	4	23	19	Ventura
General Petroleum Corp.-----	21	3	23	Barnard 16	Ventura
Pacific Western Oil Co.-----	28	3	23	S. P. Willett 2	Ventura
Penn-Kan Oil Co.-----	28	3	23	Francis 1	Ventura
Shell Co.-----	27	3	23	Gosnell 31	Ventura
Shell Co.-----	28	3	23	Gosnell 32	Ventura
Shell Co.-----	28	3	23	Taylor 32	Ventura
Shell Co.-----	28	3	23	Taylor 33	Ventura
Shell Co.-----	28	3	23	Taylor 35	Ventura
Triunfo Oil Co.-----	24	1	19	1	





## SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

## MAMMOTH TUSKS FOUND NEAR OROVILLE, CALIFORNIA

By G. DALLAS HANNA \*

About 12 miles south of Oroville, California (Sec. 25, T. 18 N., R. 4 E.), a considerable deposit of clay has been located and a plant for the manufacture of brick has been established and operated by Messrs. Charles W. Lund and Nelson E. Lund. While preparing a drain to the clay pit in November, 1928, Mr. Nelson E. Lund and his son Donald uncovered two very large and beautifully preserved tusks of the mammoth. Their position in the pit is shown in the photographs taken by Mr. Walter W. Bradley, reproduced herewith.

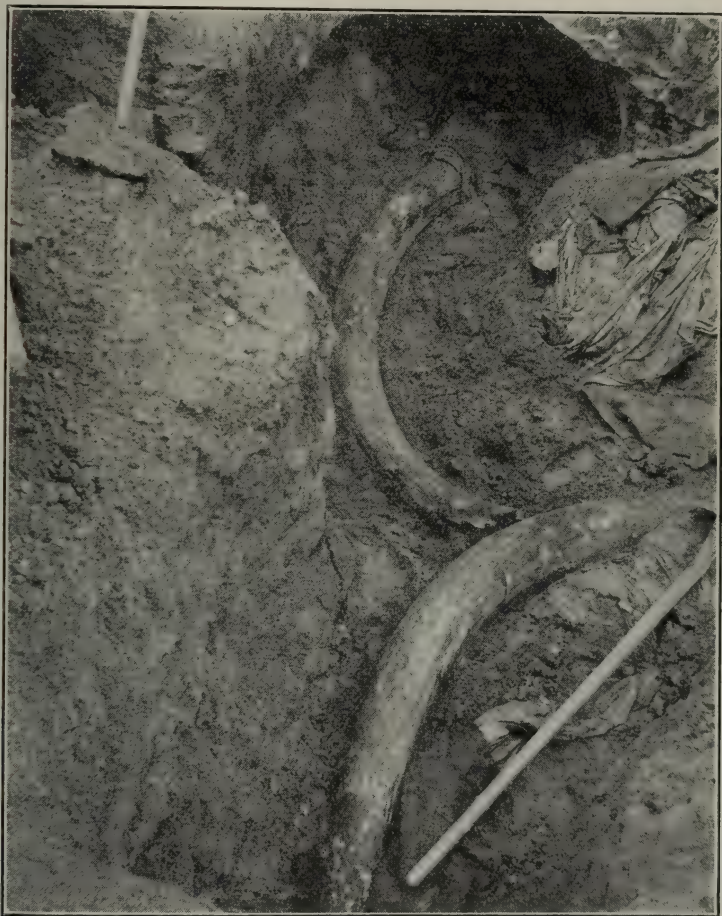
The tusks were embedded in a coarse sand and gravel deposit underlying the clays and 34 feet beneath the surface. They were in approximately a horizontal position; the bases being somewhat widely separated showed that they had been detached from the skull prior to burial. The excellent state of preservation, however, precludes the supposition that they had been subjected to any appreciable stream transport or wear. The skull or other parts of the skeleton have not yet been located. When uncovered the tusks showed scarcely a trace of weather cracks and not much discoloration. At the extreme basal ends where the tusks become hollow and thin some decomposition had taken place so that these parts can hardly be preserved. The sand thereabout had been loosely cemented and stained brown or black.

It is supposed that these tusks belonged to the species *Elephas columbi* which is the most common fossil elephant of western North America. However, if size alone be considered it may be suspected that the species is the great hairy mammoth *Elephas primigenius* of the arctic tundras. Unless more of the skeleton may be found it may not be possible to determine positively to which of these forms the giant tusks should be referred.

Mr. Lund has removed one of the tusks at the date of this writing (January 15, 1929) and has supplied some careful measurements upon which entire reliance may be placed. The extreme length around the outer curve from the tip to the base is 12 feet 3 inches. The circumference at 8 feet from the tip is 25½ inches, and at 4 feet from

\* Curator of Paleontology, California Academy of Sciences.

the tip it is 21 inches. The basal 19 inches consisted of the hollow funnel-like shell and was badly decomposed leaving the solid portion of the tusk 10 feet 6 inches long around the outer curve. The cord from tip to extreme base is 10 feet 1 inch and from tip to inner termination of funnel, 8 feet 9 inches. The other tusk is not yet sufficiently excavated for accurate measurement but Mr. Bradley, Mr. Lund and I shared the opinion that there was no very noteworthy difference in size.



Mammoth tusks found near Oroville, Butte County, California.

Photo by Walter W. Bradley.

How these tusks compare in size with the largest which have been found may be learned from "Animals of the Past," by F. A. Lucas (American Museum of Natural History, Handbook Series No. 4, 1916, p. 181). He says: "So far as the writer is aware, the largest tusks actually measured are two from Alaska, one 12 feet 10 inches long, weighing 190 pounds, reported by Mr. Jay Beach; and another 11 feet long, weighing 200 pounds, noted by Mr. T. L. Brevig." It therefor



appears that one of the Oroville tusks found by Mr. Lund is just 7 inches short of the largest on record. Dr. Lucas did not say where the Beach-Alaskan specimen is now located if it is in existence. It is expected that these Californian specimens will be permanently preserved for scientific study.

The gravels in which the tusks were found are almost certainly as old as the Pleistocene, 25,000-50,000 years. Much has been written to prove or disprove the theory that the mammoth and early man occupied North America at the same time, but incontrovertible evidence one way or another has not yet been produced. It is known positively that Europe was inhabited by human beings long before the mammoth became extinct; our artistic ancestors left pictures of the animals on the walls of their caves and on certain implements which they constructed. A considerable number of carcasses of mammoths, wool, flesh and all, have been found in Siberia, frozen in ice or gravels, and portions of at least two of these animals have been preserved in museums. No such well-preserved specimens have been found in North America, so it is probable that the species became extinct here before it did in Asia.



Mr. Nelson E. Lund, discoverer, and the mammoth tusks.  
Photo by Walter W. Bradley.



## MINERAL PIGMENT TESTS

The United States Bureau of Mines at their Northwest Experiment Station, Seattle, Wash., are beginning a series of ocher studies, and have advised the State Mineralogist that mineral pigments from California deposits will be included in these tests. They have asked State Mineralogist to cooperate in collecting samples of California ochers and to advise owners of deposits of this opportunity for having their mineral tested.

Mr. Hewitt Wilson, consulting engineer in charge of this work makes the following announcement:

We plan to wash and test these materials for color, dilution strength, oil absorption, etc., and compare them with typical commercial pigments already on the market. It may be possible to uncover new deposits of yellow ocher or other pigments which will have commercial values; and, as far as we know, the correlation and comparison of the pigments now in use have never been attempted by a state or government agency. The red, brown and black pigments are not as important as the yellow ochers, but we will test any material which you think has a commercial value. If you wish, we will return samples of the washed product.

Samples. (A) 5 pounds of each commercial washed, ground or calcined pigment ready for sale. This should cover the natural earthy materials after a simple preparation and not include the chemically prepared colors.

(B) 500 pounds of the raw material as mined from each commercial deposit in use or which would be desirable for our large scale washing test. This includes the raw material used for the 5-pound samples of "A."

(C) 100 pounds of raw material taken from any place, but which has a good color and occurs in sufficient quantity to have a possible commercial value.

(D) 5 pounds of any doubtful raw material which may be of possible interest, *i. e.*, hand samples which have aroused your curiosity.

Method of sampling. We would suggest that you use the standard methods for clay deposits given by the American Ceramic Society, Jour. Amer. Ceramic Soc., Vol. 11, No. 6, pp. 442, 443, June, 1928. The essentials in this case are as follows:

(A) Samples of powdered pigments prepared for the market. Five pounds representing the contents of several sacks or other containers, or withdrawn in small increments from a moving belt or other transporting mechanism. The coning and quartering system is used to reduce the size of samples.

(B) 500 pound samples of raw pigments as mined in an operating plant. In most plants the ocher as mined will contain a mixture of coarse and fine lumps, both soft and hard. This is usually dumped into a log washer for the dispersion of the fines and elimination of the hard material. The 500 pounds should include a representative sample of everything dumped into the washer and can be obtained by taking about 25 pound increments from 20 mine cars. This can often be done satisfactorily by the plant men during your plant inspection.

(C) 500 pound samples of raw pigments from the deposit. If the plant is not in operation, it may be necessary to go to the bank or mine and sample the exposed face. This is best done by the trenching method, *i. e.*, cutting a trench across the exposed seam in as many places as variations occur and quartering down if too large a sample is taken.

The 100 pound samples taken from river or road cuts are only preliminary or indicative at best and should be considered as such. They should be as representative as possible but usually do not include enough areal extent to cover future commercial operations. Trenching at separated points after the stained surface material has been removed is the suggested method.

Marking samples. Each sack should be tagged with a rolled linen tag suitably numbered or named and fastened to the inside of the bag near the top. Mark with a good lead pencil, roll up and fasten the tag inside after filling. Kindly mark the outside shipping tag with a duplicate number or name.

These samples should be sent by prepaid freight, express or mail (as the case may be) to the Division of Mines and Mining, Ferry Building, San Francisco, from which point they will be forwarded to the Seattle Experimental Station by the State Division of Mines, on government bill of lading.

When forwarding samples, the following data so far as they can be supplied, should also be sent to the Division of Mines, Ferry Bldg., San Francisco:

Numbers 5, 7, 8, 9, 10, apply only to producing plants.

1. The geology, occurrence and owner of the deposit.
2. The mineral and other impurities.
3. The probable quantity available, thickness of seam, areal extent, etc.
4. The state of development or commercial history.
5. The tonnage produced yearly or monthly.
6. The access of transportation.
7. The flow sheet of mill.
8. Type of product in which pigment is used, such as paint, oil cloth, mortar, cement, stucco, etc.
9. Any estimated costs of mining or purification available.
10. Selling price, F. O. B. cars at plant.
11. General interest data obtained from the plant men regarding market conditions, competition with foreign materials, manufacturing troubles and new or special equipment.

## AMERICAN MANGANESE PRODUCERS ASSOCIATION

The State Mineralogist is in receipt of the following communication, which will be of interest to producers and operators of manganese properties:

AMERICAN MANGANESE PRODUCERS ASSOCIATION

Washington, D. C.

January 18, 1929.

DEAR SIR: Congressional investigations for readjustment of tariff are now underway:

The manganese tariff hearings were held before the Ways and Means Committee, House of Representatives, Washington, D. C., on January 14th. About thirty manganese producers from various parts of the country were present. In presenting the argument, short addresses were made by Harold A. Pumpelly, E. A. Fritzberg and the writer. A written brief was filed covering the situation of the industry as a whole. A tariff of  $1\frac{1}{2}$  cents per pound on the metallic manganese content of the ore was asked for. This increase is needed in order that domestic ores may serve domestic markets in competition with foreign ores.

Ferromanganese is the product of the manganese industry which compares with pig lead or slab zinc. The manganese content of ferromanganese sells for approximately 6 cents per pound. Slab zinc sells for approximately 6 cents per pound. Pig lead sells for approximately 6 cents per pound. The lead content of lead ore carries a duty of  $1\frac{1}{2}$  cents per pound. The zinc content of zinc ore carries a duty of  $1\frac{1}{2}$  cents per pound. The association submits that manganese ore should likewise carry a duty of  $1\frac{1}{2}$  cents per pound. Since this duty is absolutely necessary for the further development (in lieu of 1 cent per pound, the present rate) and expansion of the manganese industry, and since manganese is of vital importance to the industrial welfare and security of the nation, it is sincerely believed that proper tariff protection will be granted by our government.

The matter, however, must be properly presented to both the House and Senate. Our appeal has been made to the Ways and Means Committee. It goes next to the subcommittee for further investigation. \* \* \* The manganese tariff will have strong opposition from certain consumers of the metal. Full information must be presented by the industry in order that the legislators may have possession of all the facts.

All owners and operators of manganese properties and all persons directly interested in the development of the domestic manganese industry should immediately write their Congressmen and Senators, giving them concrete facts of the manganese developments now going on in their district and the reserves available. They should state whether or not an increase in tariff is necessary for the further development of these resources.

In order that the association may be kept informed of the data being submitted to Representatives in Washington, duplicate copies of such communications should be sent to the Washington office of the association.

Very truly yours,

J. CARSON ADKERSON, President.



## SOME SPECIAL METHODS AND MACHINES FOR RECOVERY OF GOLD AND PLATINUM IN PLACER DEPOSITS

By C. McK. LAIZURE

Of the few metals which occur in nature in native form, gold and platinum are the two most valuable that commonly are found in alluvial or placer deposits.

In the early working of virgin placers it was possible to recover a large proportion of the gold by very simple appliances and without great effort or expert knowledge. All the methods used were based on the fact that gold has a higher specific gravity than most other metals or minerals, which causes it to resist the action of moving water, while the lighter materials are readily acted upon and thus separated from the precious metal.

Methods and appliances have changed as the richer deposits have been worked out and the recovery of payable quantities of gold became more and more difficult. From the beginning of placer mining to the present time these methods include use of the miner's pan or batea, the rocker or cradle, the long tom, the ground sluice, the riffle-box or sluice, booming, hydraulicking, dredging, beach sand work, dry-washing, mechanical handling and drifting. In all of these methods actual mining and recovery are combined more or less closely into a single operation.

Some deposits contain only heavy gold; in others the gold is in a very finely divided state or accompanied by large amounts of heavy black sand or the deposit may be situated in a region where no water is available for working. To meet these conditions numerous schemes have been proposed and new devices developed to increase the efficiency of recovery.

The 'inventors' of fine or 'flour' gold and platinum-saving machines, 'black sand' machines and other gold-saving devices are legion in number. Some of these schemes are little more than 'ideas,' others have been developed to a point where they may be shown on paper. Still others have been patented and machines built and tried out with more or less success under certain conditions, and a few machines or appliances have proved their worth, been adopted as valuable additions to the technology of placer gold recovery and used in placer mining operations on a commercial scale.

A number of these methods and devices have come to the attention of the Division of Mines and Mining in the past several years. During the same period numerous inquiries have been received from persons wishing to learn of any new process or machine that promised success in solving their gold or platinum recovery problem.

It is thought that the ingenuity shown in developing these processes will be of interest even to the layman and that the gathering together and publication of information on this subject may be not only of interest, but possibly of some value as well, to many owners of placer deposits.

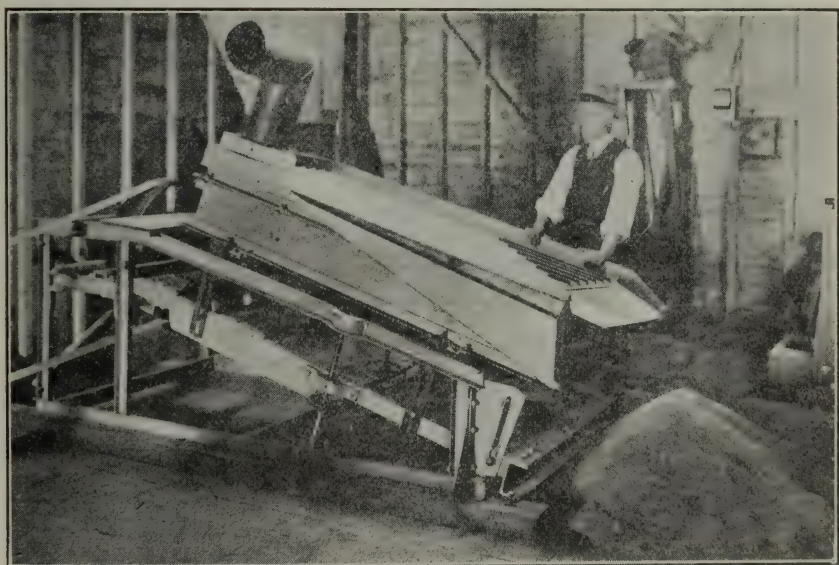
In no instance has any machine, device or process here described been tested or approved by the Division of Mines and Mining, although some of them have been observed in operation by representatives of

the division. Their merits and demerits or suitability to any given conditions must be determined by those directly interested.

The information given has been obtained in most cases from the owners or manufacturers of the machine or proponent of the process, from advertising matter, and from users, or it has been gathered from various published articles and the Division of Mines and Mining can not assume responsibility for any claims or statements made.

Where known, the name and address of the party exploiting any of the processes or machines will be supplied upon request.

*American Dry Concentrating Company*, of which Walter Duisenberg is president, has in recent years perfected a dry machine, which works solely by intermittent air pulsation. The riffles are diagonally placed, the table is self-clearing and cleaning, and one table will handle from 60 to 100 tons per 24 hours. This table has been thoroughly tested in the field and is said to be an absolute commercial success.



Side view of concentrator of the American Dry Concentrating Co.

In a test run made by Abbot A. Hanks, Inc., this firm states in their report as follows:

\* \* \* "Figured back against the original ton of gravel, the value recovered in the concentrate indicates that the gravel used in this test is worth \$2.18 per ton. As stated above, the entire tailing from the test was carefully sampled and a sample of some 60 pounds taken to our laboratory for assay. Special assays were made on this tailing in duplicate. These checked exactly and showed a gold value remaining in the tailing of 6/10 of 1 cent per ton of tailing." \* \* \*

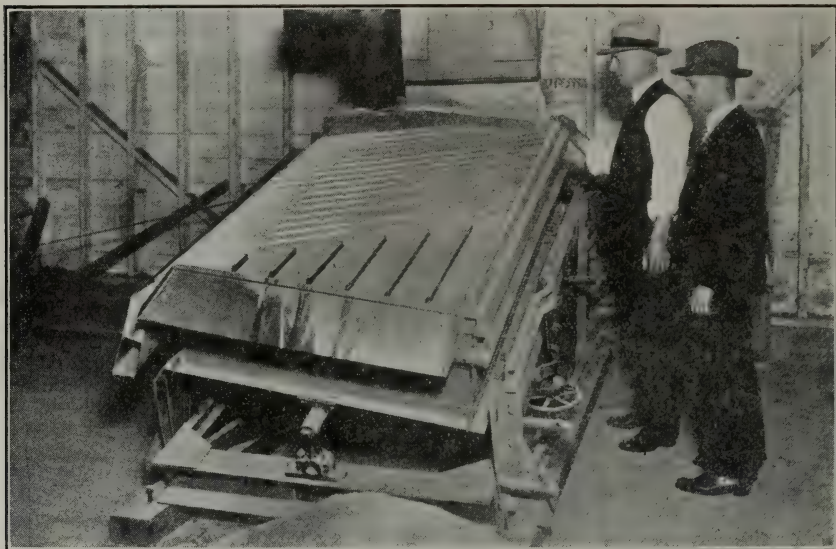
This machine will successfully concentrate platinum, gold, tungsten or any other materials that have a reasonable amount of specific gravity.

*Beach Sand Concentrator.* One of the simplest types of machine used on beach sands consists of a plain duckboard riffle fastened to a plank bottom, which is set out near the edge of the sea as the tide is



coming in, and is kept constantly in such a position that the outgoing waves will wash the gold-bearing black sands over it. This machine has been used near Crescent City, and has paid day wages to the men operating it.<sup>1</sup> It is weighted down with rocks to prevent floating.

*Bennett Air Gold Saver.* The inventor of this machine spent a number of years as a prospector and field scout for mining corporations



End view of concentrator of the American Dry Concentrating Co.

in Mexico, Lower California and other waterless regions containing dry placer gold deposits. He was later engaged in the construction of large pipe organs. Combining his knowledge of the use and handling of air in pipe-organ work with his realization of the usefulness of a dry placer machine for such districts, he developed the Bennett air gold saver. This machine is said to differ from most dry washers in that it uses a pressure box, the vibrating air column being under pressure the action of the machine somewhat resembling that of a jig. On account of the suspension of the material by the air pressure during its travel through the machine there is practically no wear on the special cloth under the riffles.

It is stated that damp as well as absolutely dry gravel can be successfully treated and 85% recovery of all gold obtained. The practicability of the Bennett air gold saver has been demonstrated at Quartz Mountain, Nevada, and near Oatman, Arizona, where dry placers have been worked successfully. The complete machine weighs about 375 pounds. Test runs will be made in Berkeley.

*The Berdan Pan.* This is not a new device. It has been long known and has been described in *Engineering and Mining Journal*<sup>2</sup> several

<sup>1</sup> Haley, Chas. S., *Gold Placers of California*. California State Mining Bureau. Bull. No. 92. 1923.

<sup>2</sup> *Engineering and Mining Journal*, New York, Vol. 106, No. 25, Dec. 21, 1918, and Vol. 125, No. 19, May 12, 1923.



times, but still there are probably many mine operators who are not familiar with it.

It is a valuable adjunct to a mill in cleaning up but is also useful in treating black sands for the recovery of fine gold, due to its grinding action and scouring effect on 'rusty' gold.

The standard size of Berdan pan is about 5 feet in diameter. The pan consists of a circular trough mounted on a steel driving shaft set at an angle in a frame and driven by gearing at a speed of from 10 to 15 revolutions per minute. A large ball travels in the circular trough as it revolves. The material to be treated is fed in continuously by automatic feeder or at intervals by hand, and a stream of water enters with the feed and continuously overflows from the lowest point on the lip, carrying off the tailing. The fineness to which the material is ground can be regulated within certain limits by the amount of water admitted.

The ball, which weighs about 120 pounds, rolls in a pool of mercury so that any free gold or 'rusty' gold that has been brightened by the grinding action will be immediately brought into contact with the quicksilver and amalgamated. The speed is so slow and action so quiet that practically no quicksilver is floured.

The actual grinding capacity of the pan is small, but it is well adapted for treating small lots of black sand, concentrates or finely-ground free-gold ore. The power required is negligible.



Brewer dry washer, Summit diggings, Kern County, California.

*Brewer New Gold Pan and Dry Washer.* This machine is built of wood and in various sizes from a small hand-operated prospecting machine which can be easily carried about to larger sizes suitable for small power unit operation.

The principal parts are the frame and bellows, and above the bellows the removable riffle board with porous bottom through which the air

is forced from below in rapid pulsations. The bottom of the riffle board consists of a light metal screen such as ordinary window screen and a layer of special bolting cloth with cross pieces underneath the riffles supporting it. The frame holds the riffle board at an angle of approximately  $30^{\circ}$  from the horizontal.

While there is nothing new in principal in this machine, the builder claims special efficiency through careful attention to certain construction details which insure tight joints so that no very fine gold is lost. Loss of fine gold may easily occur if a machine of this type is carelessly assembled. Instructions for making are furnished to those who prefer to build their own, rather than buy.

*Brewer Dry Washer.* This machine as used at Summit diggings, Kern County, is shown in the photo herewith. It is of the same general type as the Brewer new gold pan and dry washer, though developed by a different party with a similar name. A smaller folding hand-portable machine is also made.

*Burch Gold Concentrator.* It is reported that a new type of gold concentrator is to be made in Sacramento by Reeder's Machine Works, known as the Burch concentrator. The machine is described as a trough 36 inches wide and 12 feet long with nine concaves in the bottom and nine paddle-wheel agitators which wash the gravel over the ridges, depositing the gold and heavy sand in the concaves. A recovery of 98%, larger capacity and a smaller amount of water than is usually required are claimed for the machine.

*California Dry Ore Concentrator Company.* This company advertises that it has the only dry ore concentrator that is dust proof and fool proof and recovers 95% of values. First cost very low, operating cost more economical than any other. Requires small space. Installations from five tons daily upward. Further particulars may be obtained from the company.

No mention is made of placer operations and it is not known whether the machine is intended to work dry placers or not. It may be a magnetic concentrator.

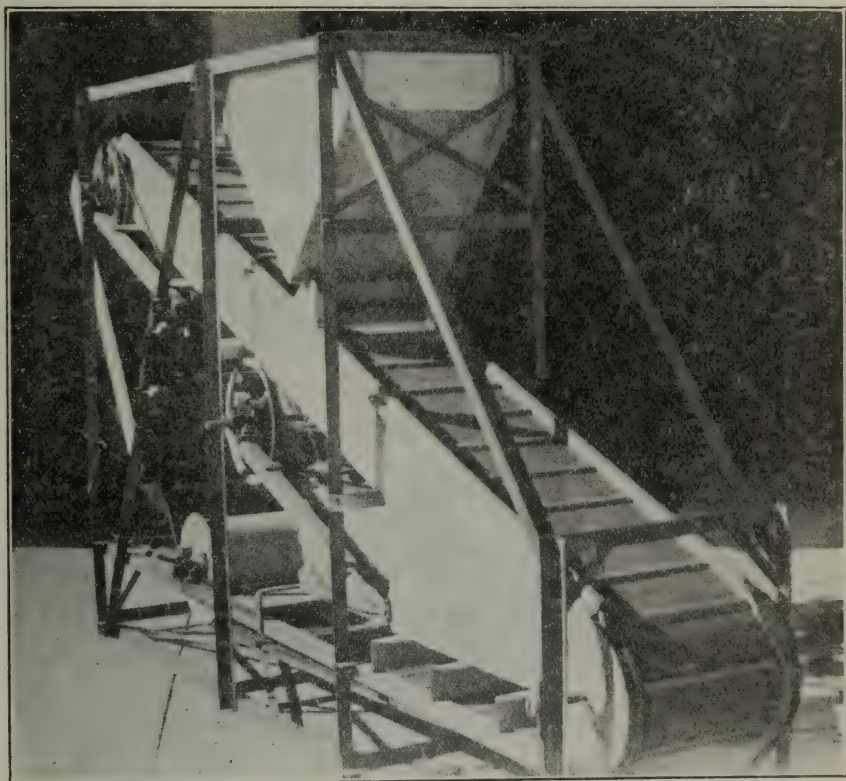
*Centrifugal National Concentrator,* apparently is designed primarily to handle low-grade complex ores as a circular describing it makes no mention of its use on gold-bearing sands or placer material. The machine is said to be automatic and continuous in operation employing centrifugal force, doing with solids that which centrifugal cream separators accomplish with liquids. It is claimed that this concentrator will save and separate values of microscopic fineness not amenable to recovery by present methods of concentration and that it requires no chemicals or other outside agencies except water in its operation. A unit treating 200 tons of ore per day of 24 hours will occupy 100 square feet of floor space; may be operated by one man per shift and will consume less than 5 horsepower.

*The Chase Concentrator.* The Chase concentrator is said to be applicable to placer, hydraulic, dredge and quartz mining enterprises. It is a stationary table, free from all motion therefore requiring no power. Classification and concentration are carried out solely by controlling the action of running water.



*Cole Dry Separator.* According to the manufacturers, their latest machine is designated for both ore or placer, and has a capacity of approximately three yards per hour of placer, or four tons per hour of ore.

The machine is so designed that almost any richness of concentrate can be obtained by slowing down the moving belt. The tailings are discharged from the lower end of the machine while the concentrates are deposited from the head of the machine into a container. It is possible to concentrate as high as sixty to one with this new unit. When the material to be concentrated leaves the hopper it passes down



Cole Dry Separator.

over a moving belt which carries the concentrated material up to the top of the machine; when this material passes under the point of feed the concentrating action is still in full force which in turn throws any gangue over the riffles and leaves the materials as clean as possible; the gangue then travels down the moving board and meets the heads where it is reconcentrated. This action is repeated as long as the heads are passing over the riffle board.

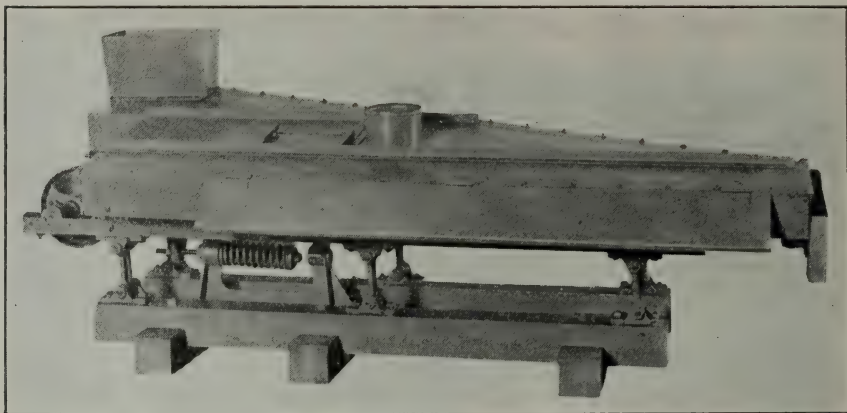
From tests on some ores extractions as high as 89% have been made. This was done on free-milling ore, by grinding it to minus forty mesh: and with placer, where the gold is free, practically everything can be saved, meaning over 97%.



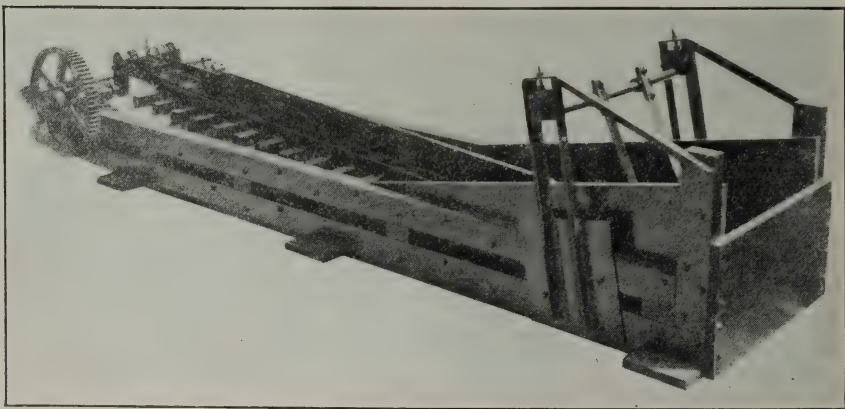
*Cottrell Pneumatic Portable Dry Washer.* This machine is designed solely for dry placer operations and can be easily handled by one man. Fitted with screen and elevator and mounted on skids it makes a light portable unit.

It is manufactured in all sizes with a capacity of from 1 to 25 yards per hour.

The manufacturer states that although of the simplest type yet it is built to withstand the strain to which a machine of this kind is



Cottrell Dry Concentrator.



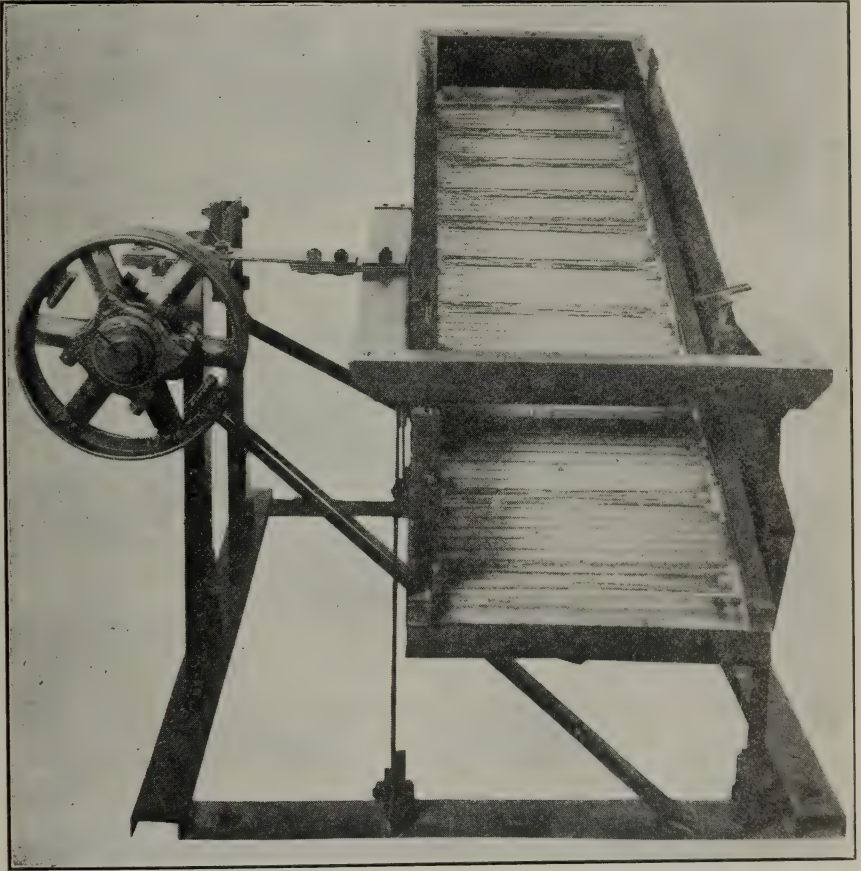
Cottrell Wet Placer Machine.

subjected, the best materials being used and all parts made accessible. The riffle board is of perforated corrugated steel and is removable for cleaning purposes.

Air is supplied by a constant blower and the machine is given a side motion by means of an eccentric. The air pressure is regulated by a valve and the angle of the riffle board may be adjusted to suit requirements. A screen and cover can also be fitted and the machine may be obtained complete with engine, blower, screen and elevator, or as a separate unit.

This company also manufactures a pneumatic dry concentrator for the concentration of various metallic ores, and in the nonmetallic field for the separation of crystalline silica from pumice, ash and sulphur from coal, etc.

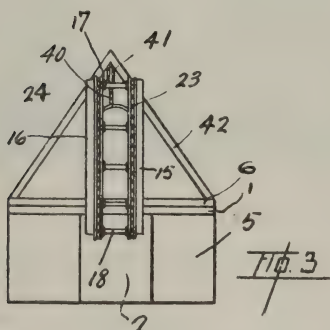
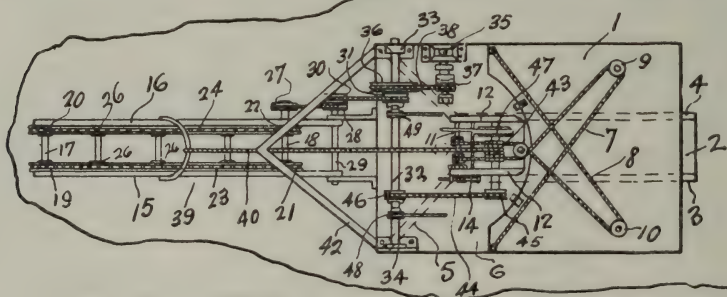
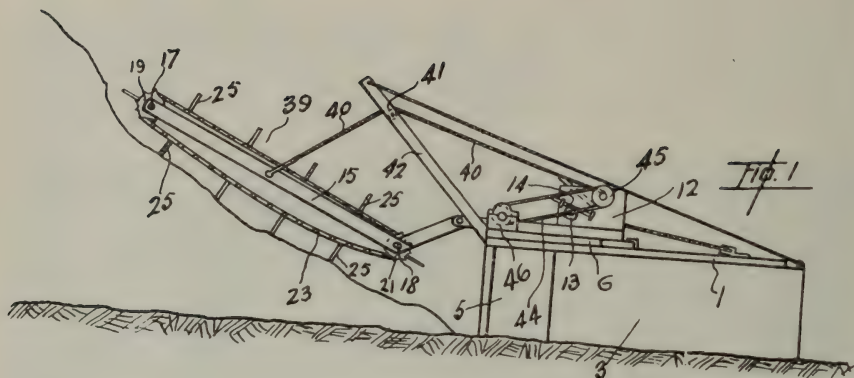
*Cottrell Wet Machine.* The same company manufactures a simple wet machine in which an undershot flow of water causes flotation, the gangue is removed by a mechanical system of rakes and the gold settles down into a specially prepared compartment. A capacity of



Cottrell Dry Placer Washer.

approximately 50 tons per hour may be handled by the standard 12-foot machine.

*Cunningham Process,* for recovering gold and platinum in river placers. It is stated that in this mining scheme it is proposed to use the river bed itself as a natural sluice, the idea being to lay a series of pipes across the stream on bed rock. These pipes are slotted so that black sand, gold and platinum being carried along the river bottom by the natural current will work through the slots and collect in the pipe just as these minerals collect in natural crevices in the bedrock.



Dunham Ground Sluicing Machine.

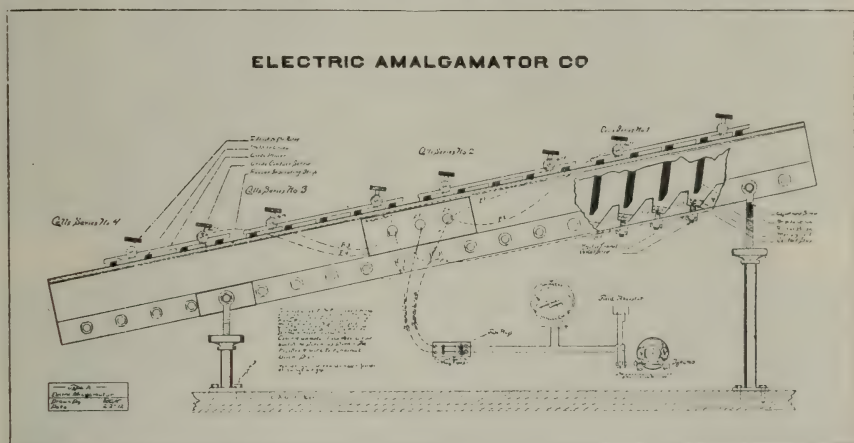


Means are provided for removing the collected material from the pipes. Apparently once installed there would be little work connected with operations.

*Douglas Manufacturing Company*, is said to have a machine on the market which will save 99% of flour gold. Details concerning the device will have to be obtained from the makers.

*Dunham Ground Sluicing Apparatus.* U. S. Patent No. 1380642. According to the patent specifications, "The invention relates to improvements in apparatus for sluicing placer ground, and the object of the invention is to provide an apparatus the use of which will increase the efficiency of the water used in hydraulicking such ground and reduce the number of men required to work it, thus rendering it possible to develop properties of this nature at a profit where at the present time it would not pay to install a hydraulic plant."

The manner in which the apparatus operates may be briefly described as follows: The ground having been sloped to the proper rake the



Electric Amalgamator Company's Apparatus.

apparatus is moved into position with the rear end of the channel abutting the forward end of the first sluice box. The framework (39) is then lowered until the fingers (25) are in position to scrape the surface of the ground to be operated on, after which the chains are set in motion, whereupon the fingers will loosen up both the ground and any boulders therein, so that the water directed thereon at the same time will readily wash the loosened ground into the sluiceway (2) and carry it along into the sluice boxes, the entire operation being effected mechanically and without the use of manual labor for loosening the ground, thus enabling a greater area to be washed in less time and with less expense than at the present time.

*Ehorn Placer Machine.* A machine for saving fine gold said to have given good results was operated on Little Butte Creek, 9 miles southeast of Chico by Cap. Ehorn. Its construction is not known. It may be the Giffen machine referred to later or a similar apparatus.

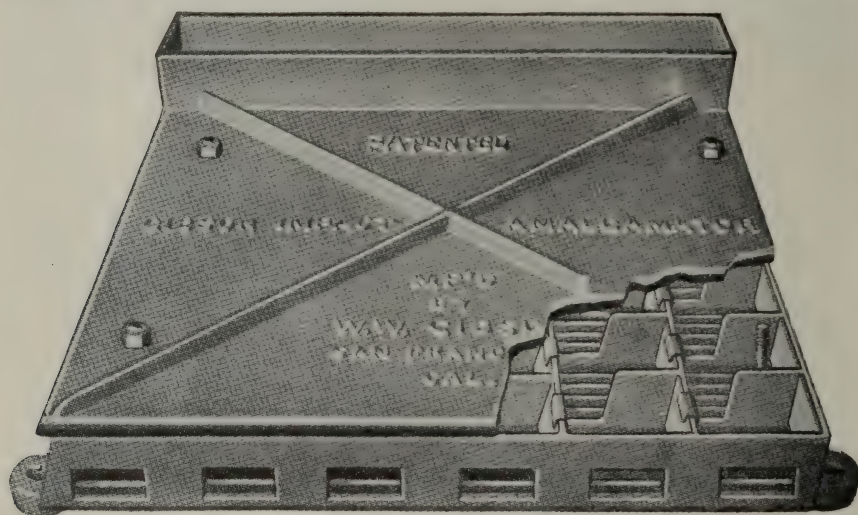
*Electric Amalgamator Company* manufactures a patented electric amalgamator which appears from a circular to be applicable mainly

to milling practice as no mention is made of its adaptability to placer operations.

*Elms Machine.* A gold saving machine said to be good on fine gold. This may be one of the machines described under another name or a different device. Details will have to be obtained from the owner.

*Ferguson Forced Feed Amalgamator and Concentrator.* The Ferguson machine is said to be based on the principle of revolving paddles and a washing process which deposits the finest particles of metal into a concentrate box, where it is drawn off with a special amalgam. Several of these machines are said to have been installed and operated in Mariposa and Humboldt counties. They are made with capacities of 25 to 500 yards per day. A recovery of 98.9% is claimed.

*Gibson Impact Amalgamator,* is a patented amalgamator made of aluminum. The No. 1 of 30-ton capacity has 42 compartments, 216



Gibson Impact Amalgamator.

riffles and 12 feet in length of silvered plate. The No. 2 or 125-ton amalgamator has 99 compartments, 1000 riffles and 66 feet in length of silvered plate. Each compartment has a small silvered copper plate standing on edge. The bottom of each compartment has a grooved floor which leads the heavy particles of gold and amalgam towards the plate.

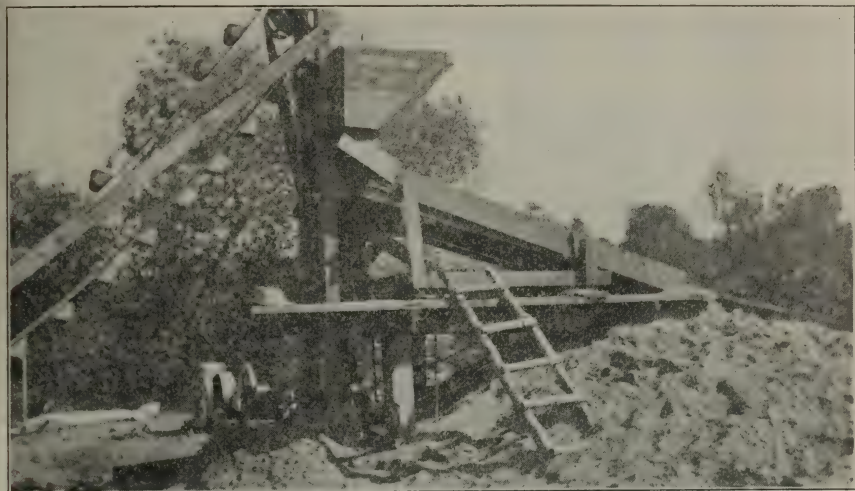
In milling practice it is customary to attach the amalgamator to a concentrating table, the table feed passing through the amalgamator before entering the table distribution-box. For dredges or placer mines a special head-motion is furnished which gives the amalgamator the same motion that a concentrating table has. It is this motion which causes the impact wave.

Rusty and tarnished gold is subject to a continuous backward and forward sand scouring and is finally brightened so that it adheres to the upright amalgam plates. It is also said to be impossible for fine gold to float through the Gibson amalgamator as the cover is provided

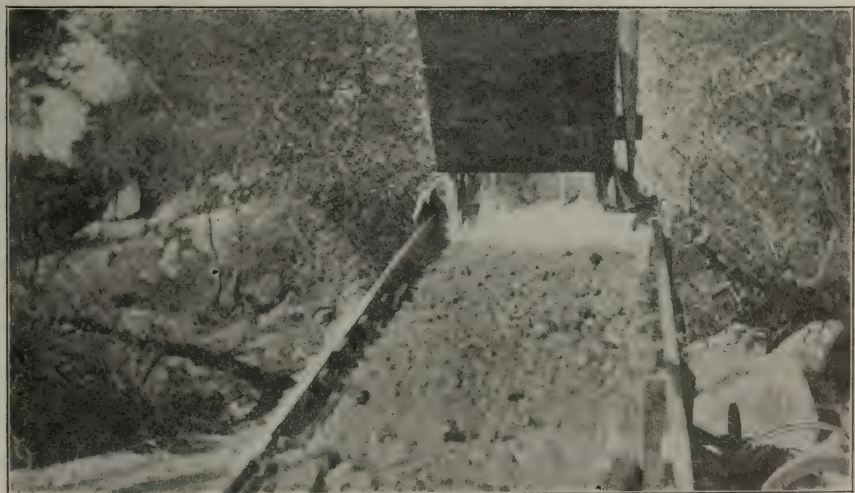


with a rubber gasket which makes it water-tight and all the feed has to pass under water from compartment to compartment.

*Giffen Placer Machine.* This machine which is adapted to localities where water is scarce is described by Haley<sup>1</sup> as follows: The machine consists of either a shaking or stationary hopper and water feed under pressure in the hopper, a shaking table with a side motion, set at a



Giffen Placer Machine. General appearance of plant.



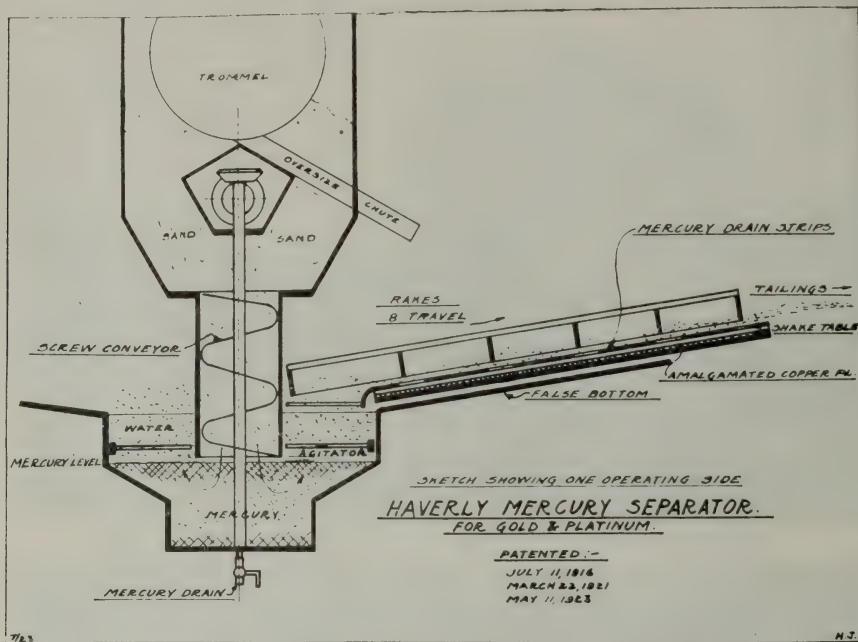
View of Giffen Placer Machine. Taken when washing 24 yards per hour, at Rocklin, California.

pitch averaging about 3 inches to the foot, and a type of riffle known as the Giffen riffle. The inventor claims that near Manhattan, Nevada, he could wash 40 yards of dry gravel with a supply of 9 gallons of water per minute, for 6 hours a day, the consumption being 80 gallons

<sup>1</sup> Haley, Chas. S., Gold Placers of California, State Mining Bureau, Bulletin No. 92, 1923, p. 68.



per yard. By the use of a trommel, the amount of gravel washed is materially increased. The dirt is fed into the hopper by an elevator. As the dirt dumps and spreads out, it is met by the water discharge, which thus gives a fair washing before the gravel reaches the table. The upper 18 inches of the table has another riffle, thus allowing the dirt to spread and cross the table in a thin wide stream, which causes



a very fair degree of concentration to occur before the first riffle is reached. Four sections of riffle each 16 inches long were used, although it was only necessary to clean the upper one daily, the second every other day and the other two once a week. Where water is scarce, it is pumped back and used over and over. The plant can be moved and put in operation in less than one-half a day. The inventor claims that under ordinary circumstances the ground can be delivered, washed, and the tailings cleared away, so far as necessary, for 30 to 35 cents per yard.

*Gold Finder.* A portable dry gravel washer. Price \$50. No other details are at hand except the address of the maker.

*Haverly Mercury Separator*, for gold and platinum. This machine is patented and it has been built and used with reported success. It takes very little water to operate so may be used in arid regions. The Haverly machine does not depend entirely on amalgamation for extracting but also utilizes gravity. The entire pulp or feed is forced below the mercury surface, the lighter material rising and being removed and the heavier particles, gold and platinum settle to the bottom of the mercury bowl. It is claimed that it will save the finest particles and leafy gold ordinarily carried off by water.

The sketch plainly shows the method of operation and the principals involved. The apparatus consists of a trommel for removing

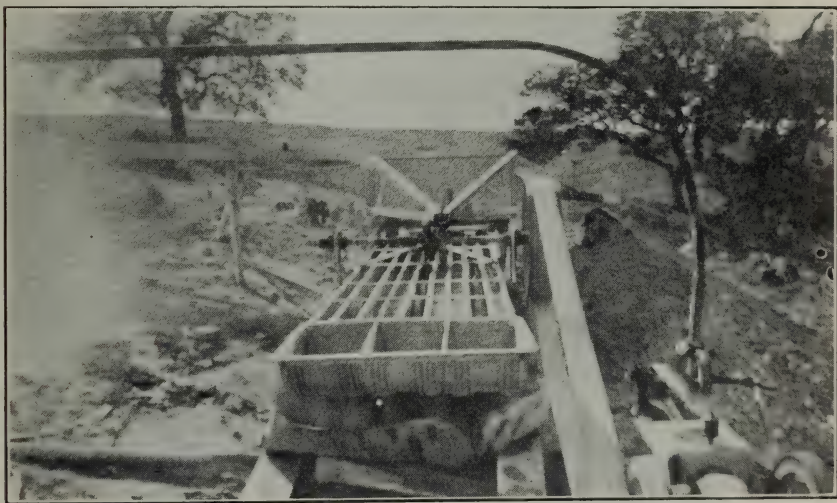
coarse material, a sand hopper from which a screw conveyor draws the fines and forces them below the mercury surface in the bowl beneath. The surface of the mercury is covered with water which is kept in agitation and mechanical rakes are provided for removing the tailing. A shaking table with amalgamated copper plate is placed below the rakes to recover any escaping gold or quicksilver.

This machine is adaptable to both placer and mill work.

*Homewood Fine Gold Placer Machine.* No details are known concerning this machine but they can probably be obtained from the originator.

*Hubbell Placer Gravel Machine.* Mr. Hubbell states that he has a company manufacturing a machine of this type for him. No description of this apparatus is at hand.

*Huelsdonk Gold and Platinum Separator.* The Huelsdonk machine has been developed over a period of 15 years during which time it has been used to a considerable extent in the treatment of placer sands and gravels for the extraction of gold and platinum with very satisfactory results.



Huelsdonk Concentrator, as operated on placer property in Mariposa County.

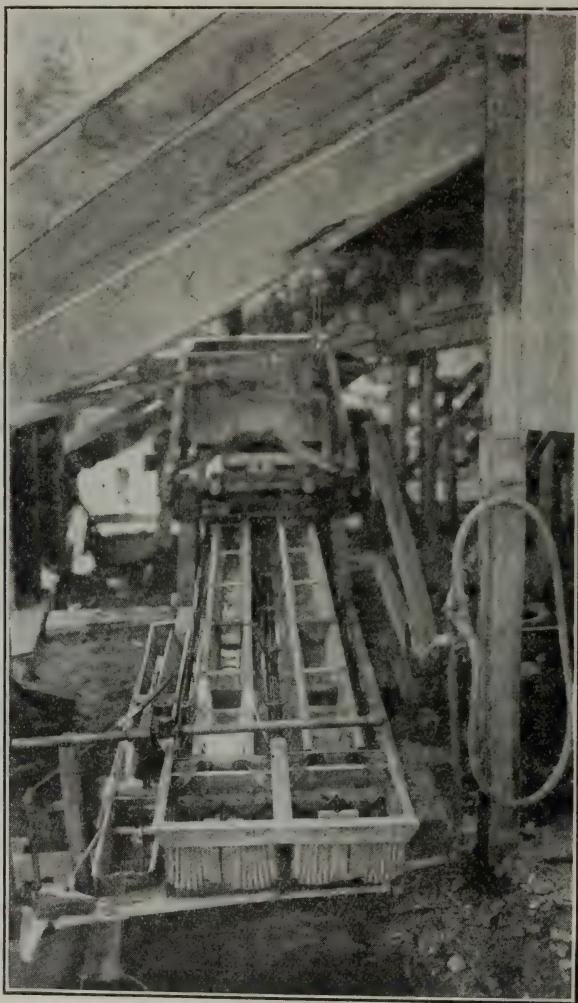
It was first known as the Huelsdonk submerged table concentrator and had been successfully used for four years by the La Grange Dredging Company in recovering platinum, gold, amalgam and mercury from black sand concentrates, when first described by Logan<sup>1</sup> as follows:

"The concentrator works under still water in a box or trough which is 16 feet long, one foot wide inside, and about one foot deep, being made from 2-inch planks. A small gas engine mounted on the sluice furnishes power for shaking the screen and the concentrator, and for pumping water. The shaking motion is given by an eccentric with  $\frac{3}{4}$ -inch travel. The screen moves on a single bolt support on each side, and the power is applied against springs. From the screen the sand and water pass on to an apron which extends one-half the length of the sluice and is perforated at regular intervals so as to distribute the sand along the table proper. This apron and the table are bolted together and are shaken at the rate of 180 r. p. m. They

<sup>1</sup> Logan, C. A., Platinum and allied metals in California: California State Mining Bureau, Bulletin 85, 1918.

travel on rollers along the bottom of the sluice, and require little power. The table proper is essentially a long narrow galvanized-iron covered trough, extending the full length of box, and tapering at the lower end to a groove scarcely  $\frac{1}{4}$  inch wide and deep. The sand enters the groove at the upper end and as the shaking motion forces it along the lighter constituents are crowded to the top and forced over the side, falling into a bottom compartment which shakes with the table and which can be used to give a middling, or to discharge tailing. The concentrate travels the length of the groove and is tapped off through the side near the end.

"Huelsdonk claims the unit can handle two cubic yards of gravel or one ton of mill tailings an hour. Twenty cubic yards of gravel give two gallons of

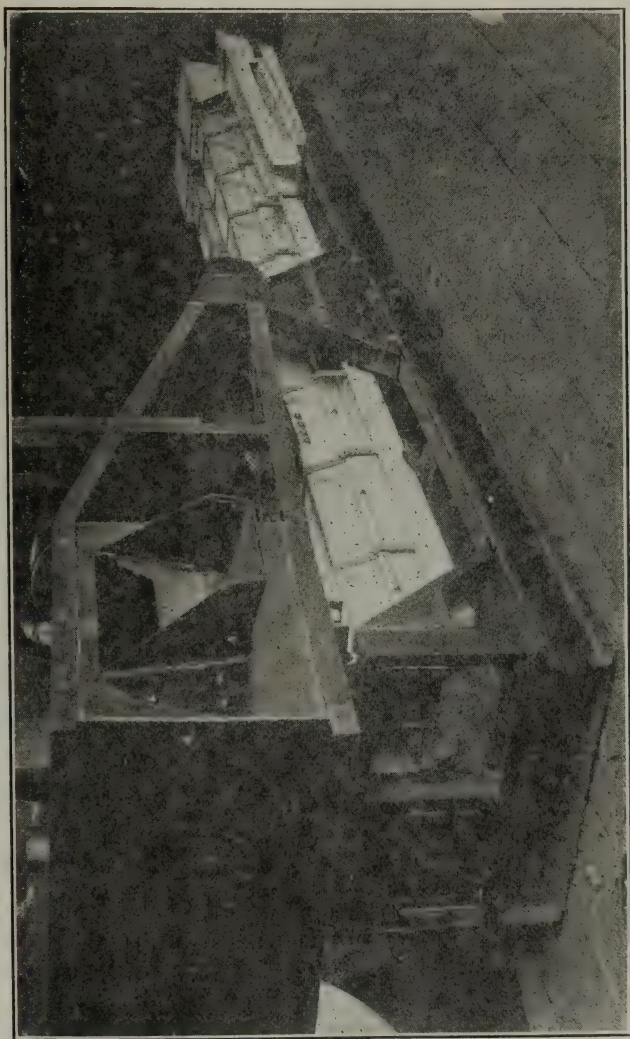


Huelsdonk Concentrator at Glazier Mine, Plumas County.

concentrate. The concentration with mill tailings is said to be 100 to 1. At the La Grange dredge 8 tons of black sand concentrate were reduced to about one-third of a gold pan full, which contained the year's output of platinum. Only  $\frac{1}{4}$  horsepower is said to be required for the concentrator. The demonstrating model has a  $1\frac{1}{2}$ -horsepower engine, which is claimed to be more than ample for pumping water and operation. A 1-inch centrifugal pump gives an ample supply of water.

"The saving by this machine appears to be very satisfactory, and the concentrator seems to have a wide field of application, but ought to appeal especially to the small miner or the man who wants a portable outfit which is easy to operate and requires little water. The installation complete, including engine and pump, weighs



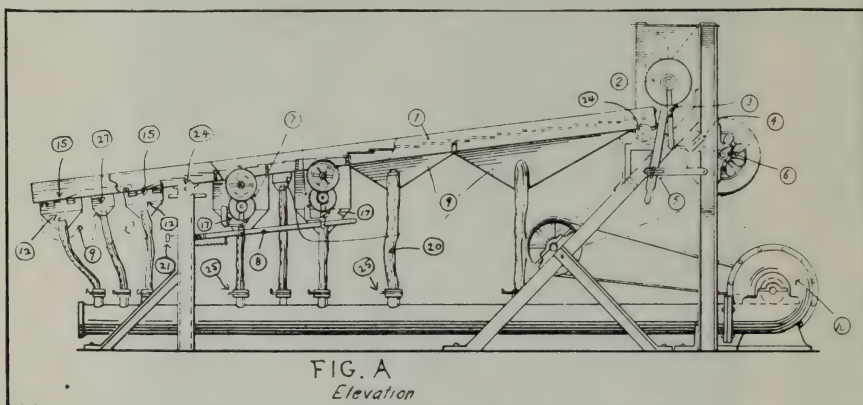


Huelsdonk Concentrator as used at Glazier Mine. Shop photograph by courtesy of W. J. McMillan.

600 pounds, and the heaviest part is the engine. Two men are required to run the outfit where hand shoveling is done."

Various modifications have been made since the above was written to meet varying conditions. The machine as recently installed at the property of the Dominion Mines and Development Company in Plumas County is shown by the accompanying photos and is described by Averill<sup>1</sup> as follows:

"Of particular interest is the Huelsdonk concentrator, a machine recently developed for gravels of this type to improve the recovery of fine gold and sulphides. The old conventional type of sluice-box is used to catch the coarse gold, as in the past, and the concentrator is placed below it, the discharge from the sluice being the feed for the concentrator. The photographs show two views of the machine. One is a shop photograph with the hopper in the foreground. The other shows the machine installed at the mine. In the background may be seen the sluice-box discharging into the hopper, which, by means of a rod and eccentric, is kept in violent agitation. The gravel is thoroughly washed, and the coarse material is rejected through the spout to the left. The fine material drops through a double screen in the bottom of the hopper to the vibrating tables seen in the foreground. These are very similar to Wilfley tables, but are made entirely of galvanized corrugated steel. The tables concentrate the fine gold and the black sand or sulphides and make an excellent recovery of them. The rated capacity of the machine is 75 tons per day. A 3-h.p. engine is required to run it. At the Vallecito Western Mine, Vallecito, California, a larger machine is handling 12 tons per hour; and the operators are very much pleased with the separation made of both the gold and the sulphides. The ideas embraced in the machine are certainly sound and result in a great improvement over the crude methods commonly used to wash gravel; and the concentrator merits the consideration of anyone who is washing placer gravels."



Johnson Dry Concentrator.

*Johnson Dry Concentrator.* The following notes and drawing have been supplied by the manufacturers.

The machine is built on entirely new ideas, and has several new features, which, together with the controls and adjustments make it a simple, efficient, and practical machine. It is built entirely of steel, on a strong, rigid, tee and angle iron frame, and is perfectly capable of standing the rough usage a machine of this class is subjected to.

The table is 2' wide and 12' long. The machine is 3' 6" wide, and about 16' long, and the hopper is 18" high. The machine weighs about 3000 pounds. It can be taken down for shipment, the heaviest part weighing 200 pounds.

The feed is a pocket roll feed of a new design. The pocket extends the full width of the table, and places the gravel and pulp in an

<sup>1</sup> Averill, Chas. V., Mines and Mineral Resources of Plumas County, State Mineralogist Report XXIV, chapter 4. Mining in California, October, 1928.

even layer the full width of the table. The feed roll is driven by a ratchet disk and lever (4) and ratchet (3). Controlling lever (5) carries a guard which disengages ratchet (3) by placing lever (5) in the central position. There is no motion imparted to the feed roll by moving lever (5). The speed of the feed roll can be increased from nothing to the full capacity of the machine while the machine is in action. Thus the operator, by simply moving lever (5), has complete control of the amount of ore fed from the table.

The method of applying the air is different from that in general practice. The air is not forced up through the ore, but passed between the riffles in a line that the ore is traveling in, which does not blow the fine values on top to be settled again or lost. The surface of the table is composed of a period of steel riffles one-sixteenth of an inch thick and over-lapping each other about one and one-half inches, and held apart by washers one-eighth of an inch thick. The air is admitted through pipe (10), slide valve (25), flexible hose (20), into air pan (9). There are a number of separate air pans to enable the operator to control the amount of air under different parts of the table, which is very essential. The air passes between the riffles in line with the traveling ore, helping its action down the table and causing an agitation the full width of the table at every riffle. The agitation causes the heavy particles to settle to the bottom as they pass down the table.

The main feature, and one that has made the machine a success, is a method of collecting the concentrates. It is composed of a corrugated roll (11),  $5\frac{1}{2}$  inches in diameter. There are two of these rolls. They extend across the table as shown in collector feed detail. The rolls are driven by a train of gears (7), and ratchet. The ratchets take their motion from a lever or rod (8), which is controlled by a set screw (21). By screwing set screw (21) in or out, the speed of the roll can be increased or decreased while the machine is in motion. By this control the operator can take just as little or as much concentrates as he desires. The advantage can be seen in being able to control the amount of concentrates taken, to suit the character of the ore handled. This is said to be a feature no other machine, has.

The operation is this: the heavy particles, having been settled, pass down the table until they pass riffle (18), which is about  $\frac{1}{8}$  inch above the collecting roll (this space can be adjusted to suit the ore handled). There is an opening under the roll of about  $\frac{5}{16}$  of an inch (this also can be adjusted). Across the opening is riffle (19), with a bevelled retarding strip attached to it. There is a  $\frac{1}{16}$  of an inch opening between the roll and the retarding strip. The object of the opening between the roll and the retarding strip is to allow the air to pass through into the ore. The air passes into the air pan (17), which is also the concentrate hopper, and passes around the collecting roll both ways. The heavier particles drop down through the opening and the air on to collecting rolls, and are carried into the hopper (17), to be discharged into a concentrate bin (not shown). The lighter particles, and also the larger pieces, are worked up the inclined surface of the retarding strip (19), and go into the tailings. Nearly all the values are caught in the first roll. The second roll is more for safety. The concentrates from it are run over again as they are very low grade. The collecting device is the main feature of the machine.



The last, but not the least feature, is the nugget collector. It will be readily seen, that no large pieces can get on the collecting rolls through the small opening. They are worked over the retarding strip (19), and pass down the table to the nugget collector (15), of which there are two. They are composed of a set of inclined riffles (15), forming a pocket. The air passes into the pocket between the riffles (15), keeping the ore agitated. The heavy nuggets settle in the pocket, which is hinged to the table by loosening a thumb nut. The nugget collector can be dropped and its contents taken out while the machine is in operation. This saves the large nuggets which otherwise would go into the tailings.

There is a device at the lower end of the table for raising or lowering the table to any desired pitch, for different classes of ore.

The table is actuated back and forth by pitman (6), and by moving the pin in or out in the slot, any desired stroke may be given the table.

This machine will handle any fine sand or it will handle loose gravels that have been passed through  $1\frac{1}{4}$ " mesh screen without any further classification. It will also handle concentrating ores that have been crushed through ordinary mill screens. It makes about the same saving of values in this class of pulp as a water table will make. Its capacity is from two yards to six yards per hour.

Taking the construction of the machine, and the new features, together with the adjustability and control of the different devices while the machine is in operation, this machine is suitable for the handling of a wide range of material. The machine is simple and can be handled by any operator.

*Kellogg Black Sand Machine.* This machine has been described by both Logan<sup>1</sup> and Haley.<sup>2</sup> Logan, in describing the method of recovering platinum from black sand obtained in dredge operations in the Oroville district, says:

"Some of the clean-up men at Oroville have made use of the Kellogg black-sand machine to recover the platinum from the long-tom concentrate. In principle, this device is an inverted funnel with pockets around the circumference. The sand and water are poured down the sides and the concentration is brought about by the boiling action when the mixture flows into the pockets. This gives a very rich concentrate about 50% metal. The machine appears to be a good saving device. A recent clean-up made with it gave  $4\frac{1}{2}$  ounces platinum. The residual black sand from the clean-up was treated chemically and was found to contain 90 grains of platinum. This would indicate a recovery of slightly over 95% with the appliance."

*Logan Centrifugal Gold Extracting Machine.* This machine, patented in 1926, is designed to save fine gold without the aid of quick-silver. It is claimed that it will make practically a 100% recovery of gold even when so fine that it will float on water. Testimonials of men who have seen the machine under actual working conditions are submitted. Most of the tests were made on gold-bearing earth in Georgia and Virginia, the machine being manufactured in the East. It is said to have a capacity of approximately 50 tons per day and is intended for placer mining, steam shovel operating, dredging, free-milling ore, old dumps that have been passed over amalgam plates, or for any conditions in which the gold can be liberated from foreign substances.

*Luckenbach Process.* This is understood to be a special mercury

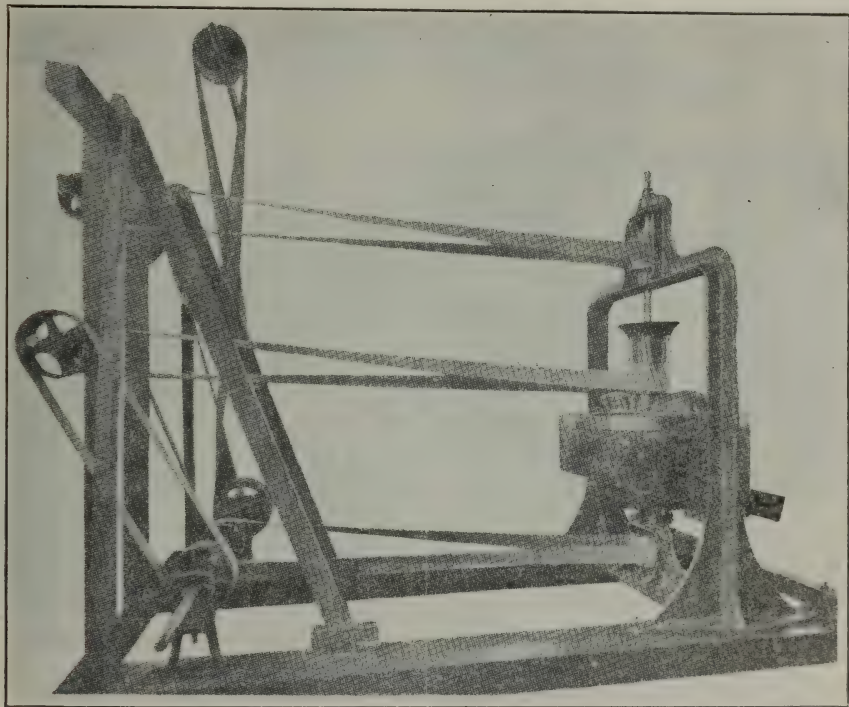
<sup>1</sup> Logan, C. A., Platinum and Allied Metals in California, State Mining Bureau, Bulletin No. 85, p. 98.

<sup>2</sup> Haley, Chas. S., Gold Placers of California, State Mining Bureau, Bulletin No. 92, p. 69.

amalgamation process, applicable to hydraulic or dredging operations for the recovery of gold and platinum in black sands. Further information will have to be obtained from the inventor.

*Macartney Dry Concentrator*, saves the values in placers, giving a 90% recovery and handles 15 tons per hour according to the announcement of the inventor from whom further details may be obtained upon request.

*Mammoth Amalgamator*. This machine operates similarly to the McBride Process (see *post*) in that it uses sodium amalgam, though produced by a different method. Further details will have to be obtained from the inventor.



Logan Centrifugal Gold Extracting Machine.

*Matrix Amalgamator*. This device, of the bowl type, according to a circular issued by the inventors, Geo. E. Banks and Harold N. Banks of Los Angeles, will recover free gold and platinum from placers and shattered ores, whether rusty, greasy, floating or other kind.

In placer operations the coarse material, larger than a pea, is screened away allowing only the fine material that carries the values to enter the bowl, which greatly increases the earning power.

In milling work the amalgamators assume the places of tables and plates. They are built in two sizes with capacity of one and two tons of fine material per hour. Power required one and two horsepower. Mercury five and ten pounds for each charge. They are claimed to have been successfully demonstrated and operated on placers in Utah.

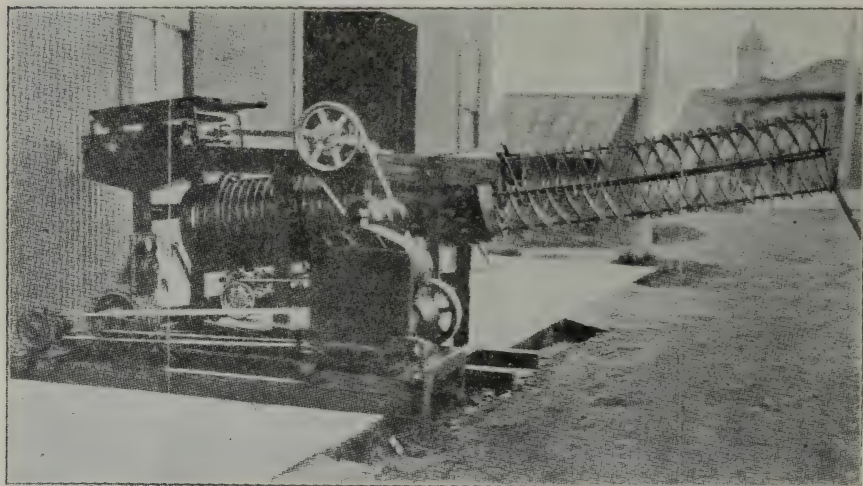


Nevada and Washington, on the black sands of British Columbia and on the Oregon coast.

*Maynard's Flour Gold Concentrating Equipment.* This party has a special system and equipment for recovering flour gold, which he claims is highly efficient. No details concerning this process are known to the writer but they may be obtained from the inventor.

*McBride Cylinder Amalgamator and Process.* The apparatus consists of a cylinder made of wood, mounted within two circular rails, which in turn roll upon trunnion bearings. Inside lining and cylinder is the plate.

Resting upon the plate is a helical 'fin flight' assembly, made of semivulcanized rubber, staggered, being interrupted at each quadrant. This spiral fin assembly suggests that which is found in an Aikens classifier. The plate, the spiral fin assembly and cylinder rotate as a unit. The fins extend upwards from the plate a few inches, varying



McBride Cylinder amalgamator showing fin assembly ready to be placed in cylinder.

with the size of the cylinder. There remains, therefore, a considerable open cylindrical space within the spiral fin assembly. Suspended within at the lowest point, just clearing the upper edges of the fins, is a carbon electrode (the anode). It is stationary and does not revolve with the cylinder plate and spiral fin assembly which revolves as a whole upon the trunnion supports. When mounted the cylinder is set so that the intake end is lower than the discharge end. Also the fins gradually diminish in height from the intake end as one progresses towards the discharge end.

The process is the application of several well-known and long-established principles and actions, so arranged and coordinated as to make use of each step in proper and useful sequence and virtually getting into step with the operation of natural law and avoiding violent opposition thereto.

The outstanding feature is providing an amalgamating plate, the mercury on which is continually being supplied with sodium, so that on it at all times is a very active sodium amalgam.



It is accomplished in this manner: the gangue of say 20% solids is introduced into the lower end of the cylinder which is closed except for a circular aperture in the center of the cover closing the lower end of the cylinder. The gangue enters by means of a simple launder. The water has salt added to it before it enters the cylinder. Sea water has been used very successfully. Now, when the pulp has entered the cylinder, the spiral fin assembly very effectively but gently rolls it progressively forward up the grade. A current of d. c. electricity is introduced, and passes from the carbon anode, through the pulp, to the plate underneath. The plate serves as the cathode.

The current decomposes the sodium chloride, and sodium and chlorine results. The sodium presumably becomes sodium hydrate in most instances and as such or sodium, passes promptly to the plate. But when it strikes the plate, the hydrogen is released, and sodium metallic is formed and it having so slight a specific gravity virtually 'pops out' again and in coming in contact with the water forms sodium hydroxide (caustic soda).

Where there is even considerable oil or grease present the caustic soda is quite sufficient to promptly saponify it, and in cases of certain oxides and other substances coating gold the inventor claims to have found the action prompt and effective in cleansing the metal for ready amalgamation. The chlorine escapes mostly as gas, for its odor is marked when the machine is in operation. Yet, considering the well-known tendency of chlorine for recombination it possibility serves usefully in other ways. In thinking of the chlorine, it should be borne in mind that the operating temperature of the process is a low one being that of the water supply.

"The effect of a current of electricity upon tiny particles of gold, silver or platinum is not clearly understood by many. Nevertheless, we have learned that it does serve very positively, effectively and usefully when applied with understanding."

The physical action supplied by the spiral fin assembly can be only compared with skillful panning. The cylinder, revolving slowly, provides a gentle rolling motion to the pulp, avoiding sliding, and yet classifying sufficiently that every particle is exposed to the amalgamating plate long before it reaches the discharge end. Therefore, the presence of black sand or magnetic ore offers no difficulty whatever, but on the contrary seems to assist in the useful distribution of the electrical current.

Under drastic test conditions it has been determined that 80% of the extraction is effected in the first 25% of the apparatus, or saying it differently, 80% of the metal extracted is recovered on the first quarter of the plate.

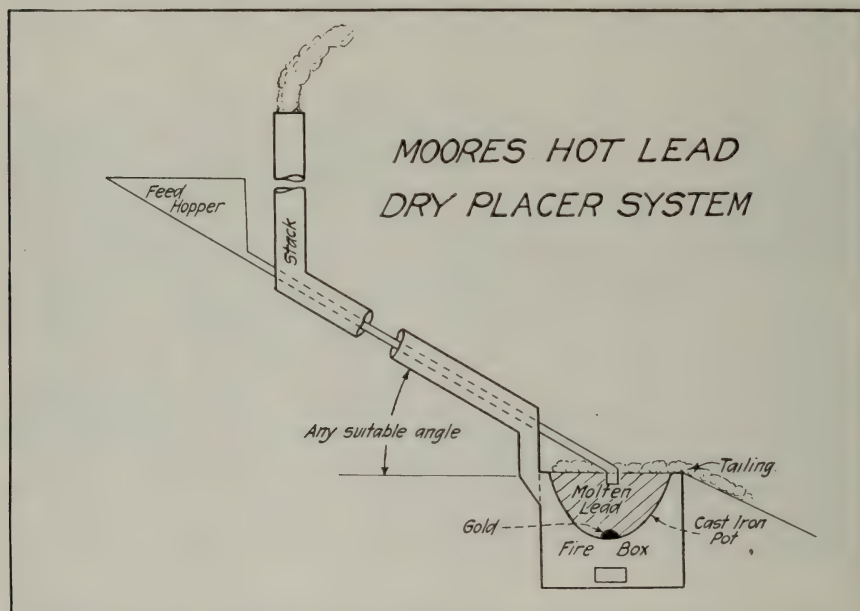
Operating upon fine sands, semi-concentrates or concentrates, competent engineers are stated to have accorded the process the extraction efficiency of 99%, while the inventor claims 95%. "It is understood that we claim this efficiency on free metallies."

The successfulness of its action is based principally on destroying surface tension. The very reason mercury flows so readily is due to the fact that because of its density and surface character, it provides for pronounced surface tension. The tiny speck of gold, even though of much greater specific gravity, does not enter the mercury when in contact with it because the surface tension of the mercury does

not permit it. The phenomenon is like that of the needle floating on water. Besides the surface tension affects the particles of gold and silver and even more so, the platinum.

Two sizes of apparatus have been developed. One is portable to the extent that it can readily be taken apart so that it can be packed on burros.

It has a capacity of not less than  $1\frac{1}{2}$  tons of fines or concentrates per hour. The cylinder is 18 inches in diameter and is 6 feet long. Additional equipment consists of a small d. c. generator, circulating pump for water, and a 4- or 5-h.p. gasoline engine. The size deemed most practical for large-scale operation, is 3 feet in diameter and 12 feet long. This size is the unit for battery installations. Its capacity is 15 tons per hour.



The smaller cylinder complete will weigh about 600 pounds. The larger one will weigh under 3000 pounds.

The items of cost of operation are power and salt. Under test conditions 3 h.p. revolved the large cylinder and supplied the needed electrical current. Salt consumption will vary from 3 ounces to one pound per ton of solids, depending on dewatering efficiency applied to pulp after treatment. There are so few moving parts and they so simple that wear is slow.

*Miller Metals Separator*, is another device for saving tailings values concerning which no details are at hand.

*Moore's Hot Lead Dry Placer System.* This scheme for recovering gold or platinum in localities where water is not available originated from watching a small boy toss an iron bolt into a pot of molten lead and noting that the iron floated. The basic idea is, that if gold-bearing sand and gravel is submerged in molten lead, the gold being

heavier than lead will sink and the other material will float and may be raked or scraped from the surface. It is proposed to feed the material into the molten lead through a pipe which is surrounded by the flue from the firebox so the gravel will become as hot as possible before it enters the lead bath, thus conserving fuel.

In an experiment Mr. Moore claims to have made a 100% recovery of filings from a gold coin mixed with sand and gravel and subjected to the treatment, stating that after cooling, the bottom of the lead mass was sawed off and all the gold reclaimed.

Any fuel may be used and if necessary a screw-conveyor or other means may be used to feed the material. The tailing may also be removed mechanically.

No particular form of construction is given but the sketch herewith will show the principals involved.

Assuming that the process itself is 100% perfect there are obvious reasons why it would only be applicable to very rich concentrations.

*Morgan's Patented Mat-o-Gold.* The mat-o-gold is a rubber slab or mat of sponge-like, cellular construction, and is the basic idea around which various mining equipment is built by the Morgan Company. It has a multitude of resilient rubber cells that constantly vibrate while in use, and catch and hold the values, allowing the lighter particles to float away. It will not slime and has great wearing qualities.

It is further claimed that it forms a perfect riffle and positively will not pack, and is easy to clean without removing from position. All the defects and short comings of blankets, carpets, corduroy, canvas, cocoa mats etc., are said to be overcome by this device.

This sponge rubber equipment has been used in the miner's pan, and rocker, in undercurrent boxes and sluices and as an endless belt on vanners being adaptable to both placer mining and gold milling practice.

*Parker's Gold-Trap Process.* This device for extracting gold from sand and gravel in flowing streams, the invention of J. E. Parker, is being used on a commercial scale by the Parker Process Syndicate at their property on the Vermillion River, Montana.

A detailed description of the process with photos showing the arrangement and construction of the Parker Gold Trap is contained in the Mining Review of Salt Lake City<sup>1</sup> from which the following notes are reproduced.

"The Parker Trap is an arrangement of riffles in the center and steps along the sides of a fan-shaped passage. The water pours into the narrower end of this trap with considerable velocity, which is then slowed down as the trap widens. Over the Hungarian riffles round planks were placed just far enough apart to permit the black sand and the smaller pebbles and nuggets to pass between them. Similiar planks are placed across the steps beside the riffle at an oblique angle which causes the ends of the planks toward the center of the trap to point upstream at an angle of about thirty degrees. These halt the fine gold moving swiftly with the stream and propel it toward the center, where the backward suction into the riffles tends to cause still more gold to be deposited in the open spaces under the planks.

"Recoveries are slight in the sets in the flume which were mainly to halt the flow of water and set the gravel and nuggets which it contains to boiling and settling. In the neck of the flume recoveries are a little higher, but the chief values are obtained in the pan, which is four feet across at the upstream end and about ten feet wide at the lower end. The highest gold recovery is and should be made in the second and third riffles from the lower end."

<sup>1</sup> *The Mining Review*, Salt Lake City, Utah, Vol. 30, No. 9. August 15, 1928.



*Pascoe's Dry Placer and Mill Tailing Machine.* This is not strictly a 'dry placer' machine as it requires a small amount of water to operate. No description of this apparatus is at hand. The inventor has stated that his machine was used on beach sands with satisfactory results and has submitted a copy of a report made by S. A. Storer in the form of a letter as follows:

UCLUELET, B. C., April 12, 1923.

"To Whom it May Concern:

"I have had 35 years experience in placer mining and have worked in California, Arizona and Alaska and have held responsible positions in placer and deep gravel works and happened to locate at the above address and had the pleasure of examining and seeing at work Mr. Burt and Mr. Pascoe's placer mining machine which they are operating on Wreck Beach and I further state that I have seen 30 or 40 different gold saving machines at Nome, Alaska (in 1900), and saw the machine of Messrs. Burt and Pascoe's which is the only one I ever saw that is practical. The machine is so constructed as to use the same water continuously by a system entirely their own. Water passing over the riffles to a sump and is continuously pumped back over the riffles and the only water it uses is the moisture of the sands taken out and evaporation of the sun. The machine they are using here is an 8-inch machine and will handle about 10 tons of dirt in 10 hours but there is no limit to the size. These machines can be constructed to any size desired. The gold is saved in the ordinary system of sluice boxes. The whole plant is operated with a 3-h.p. gas engine. I spent sometime in Arizona where they use the dry washer and save the gold by blowing the sand through, leaving the gold behind but any gold the same weight as the sand will be blown over with the sand. The machine in question will save the smallest particles of gold hardly visible to the naked eye.

Respectfully,

(Signed) S. A. STORER."

Patent has been applied for and a patent number assigned the invention.

*Pierce Gold Separator and Amalgamator* (The Gold Gatherer). The following general description of this device is taken from the catalog of The Mine and Smelter Supply Company.

The Pierce gold separator and amalgamator consists of numerous L-shaped copper riffles, which are treated with quicksilver. These are so arranged that the water carrying the pulp or sand sweeps all particles repeatedly against the amalgamated surfaces. The L-shaped bottoms of the riffles also contain quicksilver into which rusty gold will sink by gravity.

Riffles for placer mines and dredges, and for mills differ only in size. The principle and design are identical.

The riffles are made of only the purest and softest, annealed, Lake Superior, or electrolytic copper. They are silver-plated, if desired. They are held in position by riffle-holders which are placed lengthwise of the riffle-box, and on each side of it. There are two sets of holders, one set for the lower riffles, and one for the upper riffles, the latter being placed on top of the former. The holders are grooved strips of wood, the ends of the riffles fitting into the grooves. The riffle-box is made of sheet-iron, and the joints are lapped and riveted to make it water-tight.

The lower riffles, (D,) are bent somewhat like the letter Z. The top of each riffle is bent back in the direction of the flow of the water, thus allowing an air space to be formed behind the riffle. The bottom of each riffle is turned up at each end and brazed so as to hold a pool of quicksilver.

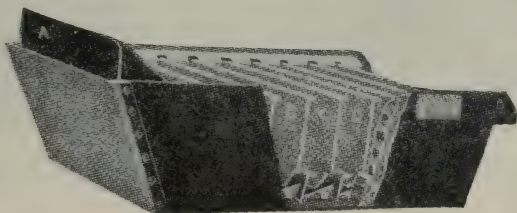
The upper riffles, (C,) are placed above the lower riffles, and extended down between them. The tops of these riffles are also bent back in the direction of the flow of the water, while the bottoms are bent toward

the flow of the water in such manner as to hold the quicksilver in the bend or L.

The Pierce gold separator and amalgamator is characterized not only by successful design and excellence of material, but by the extreme care exercised in its construction.

For placer installations one or more sets of V-shaped grizzlies are placed in the bottom of a section of the flume which is then set in the main flume or at the end of it. The bars of the grizzly are set at a slight angle from the flow of the water so that the fine gold, sand, and gravel are gradually brought to the openings and pass through them into the grizzly box. The grizzly box is supported by rods underneath the grizzly and flume. The bottom of the box slants downward in the direction of the flow of water. At the lower end there is a gate which can be regulated to take from the flume only as much water as is necessary to carry or move the gold, sand and gravel that pass through the grizzlies.

The gold, sand and gravel are then taken in a launder, or flume, to the screen boxes where the coarse gold and fine gravel are separated from the fine gold and sand. The latter pass through the screens which are adjusted by means of hand-screws so that the discharge



Pierce Amalgamator.

end of the screen is higher than the end over which the gravel first passes. Underneath the screen a gate is provided which can be adjusted to admit only the amount of water and sand that the amalgamating boxes and riffles can handle. Thus the water is kept above the screens, expelling the air from beneath them, and the flow of the water carries the fine gravel and coarse gold over them. There is not the tendency for the coarse gold and gravel to settle and stop up the meshes of the screens as is the case when air is allowed underneath them.

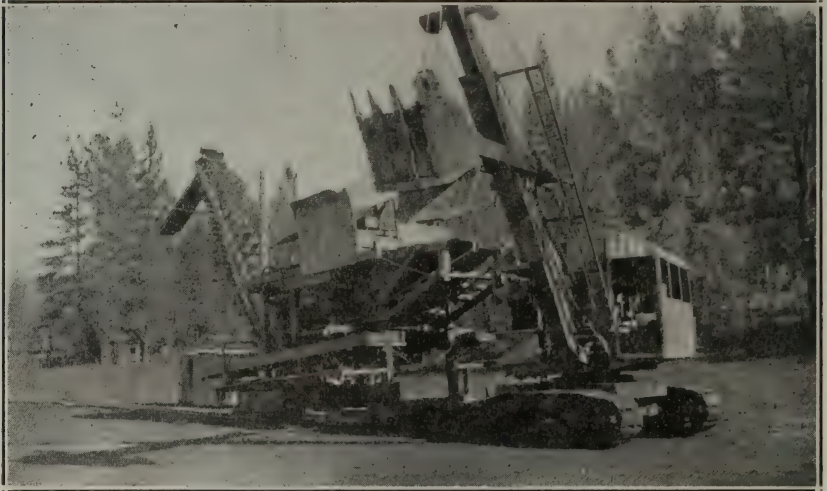
The riffle-box is set at an angle of from two to four inches to the foot, depending upon the material to be treated. The fine gold and sand pass through the screen and are then run through the riffles. The pulp flows underneath the upper riffles (C), and over the lower riffles (D). As it passes into the riffle box at (A), it fills to the top of the first upper riffle, and then passes under it and over the first lower riffle; then up between the first and second upper riffles to the top of them, where it looks like muddy water boiling; then down underneath the second upper riffle, up over the second lower riffle, up to the top of the second and third upper riffles, and so on until it passes out at the lower end of the box. The gold either adheres to the riffles or sinks into the pools of quicksilver. The sand and water are thrown out at (B).

The black sand is continuously agitated and thrown out by the water passing down between the lower riffles. And by keeping the fine, or



flour gold in the current of the water it is swept against the amalgamated riffles so many times it is impossible for it to escape.

As the coarse gold reaches the pools of quicksilver in the bottom of each of the upper and lower riffles it readily sinks into them, even though it be tarnished or fouled. This by reason of the fact that the specific gravity of gold is 5.8 points greater than that of quicksilver, in



P. & H. gasoline steam shovel and Pierce gravel gold washing machine on Jenkins and Taylor placer, near French Gulch. Photo by courtesy of Clifford Taylor.

addition to the affinity of mercurry for gold. Hence all of the gold lost in the ordinary riffle and on mill plates is retrieved in the Pierce.

*Pierce Gold Machine.* This machine as used at the Jenkins and Taylor Placer, near French Gulch, Shasta County is described by Logan<sup>1</sup> as follows:

"For washing gravel they have installed a Pierce Gold Machine, which is a small dry-land outfit patterned after one used in the placers near La Panza (San Luis Obispo County) where water is scarce. It carries a trommel about 4 feet by 16 feet with  $\frac{3}{4}$ -inch screen, through which fine gravel discharges on each side into four apron sluices  $2\frac{1}{2}$  feet by 4 feet, thence to 30 feet of sluice  $2\frac{1}{2}$  feet wide with Hungarian riffles. Coarse cobbles pass through the lower end of trommel to a bucket elevator with buckets 2 feet wide which is capable of stacking rocks 20 feet high or more. In operation this machine is dragged around on skids by the gasoline shovel which feeds gravel into the hopper. Power for the Pierce Machine is furnished by a second-hand automobile engine working through chain and gear drives. A 6-inch centrifugal pump supplies water for washing."

*Pollock's Flour Gold Concentrator.* U. S. Patent No. 1379417. The following statement is abstracted from a circular issued by the patentee:

"This device is the result of years of experience in South Dakota and Idaho, and 98% of the values may be saved by this device. It is a corrugated and perforated brass riffle placed in a slot cut transverse of the sluice box, with amalgamated copper plate under it, and an eighth to quarter-inch discharges from side of sluice box into tub or box, which will be rich and may then be panned or emptied into head of sluice box. The copper plate may extend a little outside the sluice box and have a handle on it and be changed as often as necessary with very little delay. Every sluice box needs one concentrator and some need two or three. It depends on size of proposition and amount of dirt you are handling."

<sup>1</sup> Logan, C. A., Mines and Mineral Resources of Shasta County, State Mineralogists' Report XXII, Chapter 2. Mining in California, April, 1926.

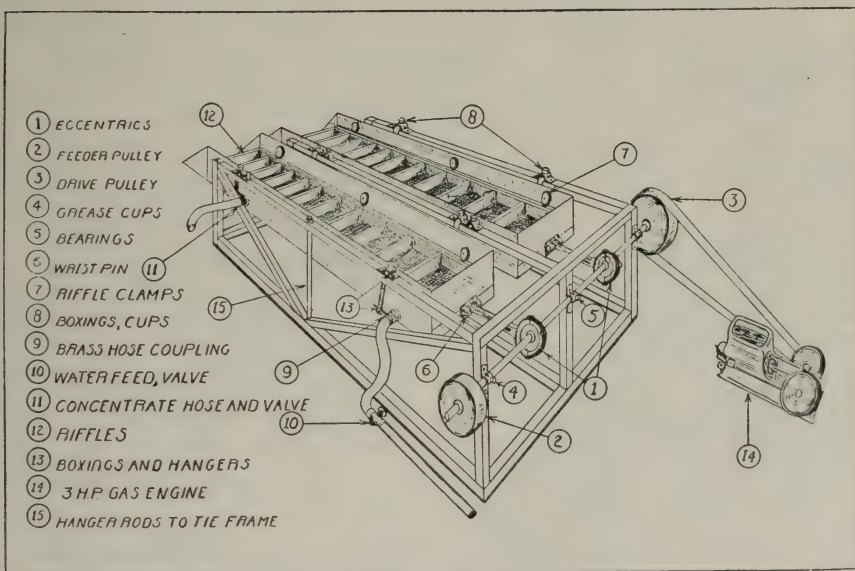


*Ratcliffe Concentrator and Amalgamator.* This machine is designed to handle both placer material and crushed ores and is said to have been successfully used on gold, silver, platinum, tin, chrome, manganese and tungsten since 1922. It uses only a small amount of water which may be pumped back and reused and requires only 3 horsepower to operate. The concentrator and amalgamator weighs 300 pounds. An engine will bring the total weight to about 800 pounds or a Ford car can be jacked up and the engine used to run the machine. The operation is described in a circular as follows:

"In gold we use silvered copper plates also a quicksilver trap. The machine is simple and easily operated, automatically fed, one ore feeder will take care of two machines. The machine will put through about two tons per hour of gravel or crushed ore—do not classify the product. The construction as follows: The riffle box is made of heavy sheet iron welded together, so there are no rivets to come loose. The box is six feet long, eighteen inches wide and one foot high. Riffles are four and one-half inches high, spaced wide at the feed end and narrow at the discharge end of the riffle box. Under the riffles we have a wooden riffle board in which holes are bored to let the water feed upward and under the riffles. The water comes up under each riffle forced by a gentle and steady flow from a gravity tank above the machine. On top of the riffle board we have a steel screen the holes of which are so fine as to let only the light or small particles of gold or concentrate through. At the bottom we have a chamber about three inches under the riffle board, we also have a silvered copper plate on the bottom covered with quicksilver to amalgamate the gold the same as in any gold mill.

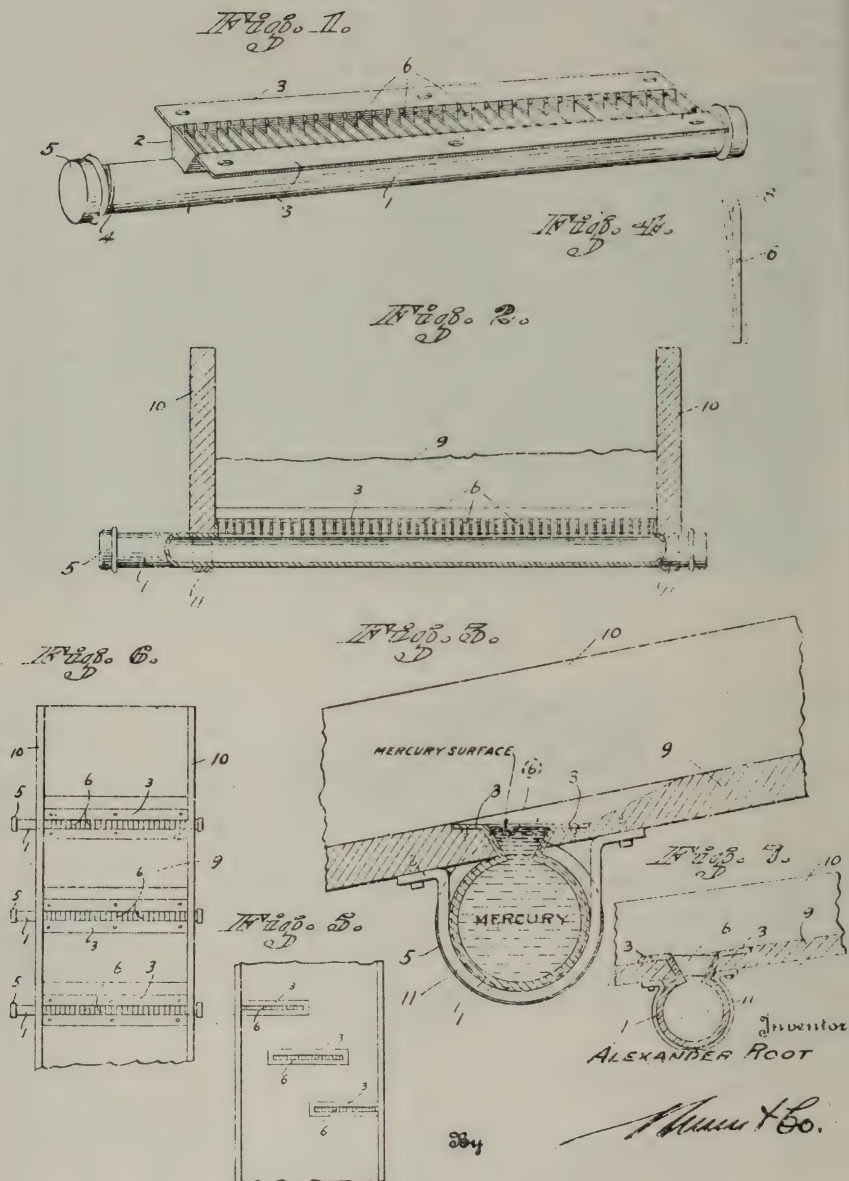
"There is a quicksilver trap to catch any amalgam that might slip off the plate—thus we save all the gold. The inlet for the water is at the front or feed end of the riffle box with a discharge at the lower end where the light concentrates run into a sump. And the slimes that may get down under the riffles will flow over the top of the sump and the heavy concentrates will sink to the bottom of the sump.

"We catch most of the heavy concentrates and gold nuggets between the riffles lodging on top of the metal screen; this is cleaned out from between the riffles two or three times a shift but we do not have to clean the bottom of the machine only about twice a week, according to the richness of the dirt you run."



Ratcliffe Concentrator and Amalgamator.

*Root's Apparatus for Amalgamating.* U. S. Patent No. 1529038. This invention relates to placer mining and has to do with apparatus for amalgamating gold and other precious metals in passing over a sluice box. The following notes are excerpts from the patent specifications.



Briefly described, the method of amalgamation consists in passing the placer sand and gravel together with water over a still body of liquid mercury whereby the values are extracted by the mercury as the material is floated over the liquid surface, and the apparatus for use therewith consists in certain receptacles for the liquid mercury adapted to be placed in the bottoms of sluice boxes, mill tables, etc., whereby the pool of liquid mercury is presented with a proper working surface to the moving sand and gravel, means is provided to prevent splashing of the mercury by large stones, a reservoir is provided for sinking of the amalgam, and an opening is provided in the reservoir for the removal of the amalgam without disturbing the setting of the apparatus in the sluice box; also other features are incorporated such as means for forming a tight connection between the receptacle and the bottom of the sluice box, easy renewal of the anti-splash features to provide for wear, etc.

In its preferred form this receptacle consists of a section of pipe of about two inches in diameter and having an opening or slot formed in one side with an upstanding wall of metal welded to the pipe all around the opening and flanged on both long edges. The pipe is closed or capped at both ends and at one end extends a short distance beyond the wall, so that the cap will be accessible for unscrewing and so that a wrench may also be applied to the pipe to steady it if desired.

The walls are preferably at a slight angle and form a sort of chute about 2 inches wide on top, leading to the interior of the pipe and transversely arranged. In this chute is a number of spaced plates or grate bars to form a screen over the chute opening.

Any form of grate or screen may be used over the opening but plates are preferred as they are easily inserted in grooves formed in the long walls or in a separate piece attached thereto.

The bars are bent or twisted a trifle as denoted by the dotted lines in Fig. 4 or else the opposite grooves are not quite parallel, so that the plates will fit tightly into the grooves and will not float out when the receptacle is filled with mercury.

The bars or plates are of iron or steel about one-sixteenth of an inch in thickness and preferably brought to a narrower edge on top and when all are in place they are about a half-inch apart and present a grate bar or screen about three-eighths of an inch below the upper edge of the chute. The receptacle is set in the bottom of the sluice box, the flanges being unequally set in the wood on account of the pitch of the box, so as to present a level surface to the upper edges of the chute, and the flanges are cemented and screwed or bolted to the bottom of the box to make a tight joint, while the ends are similarly cemented and form a tight joint with the sides of the box, and it is also desirable that the receptacle be additionally supported by straps passing around the pipe and bolted or lagged to the sides of the box.

In operation the receptacles are filled with mercury to within about one-sixteenth of an inch of the upper edge, and the sand, gravel and water is run over the sluice in the usual way and when the material strikes the clear pool of mercury above the grate bars it is simply floated across by the rushing water and discharged over the far edge of the chute, thus applying a bath of liquid mercury to the moving material for amalgamation of its precious metal content.



The grate bars provide a support for the larger stones, thus preventing splashing of the mercury, though in case of treating reduced material or pulp the grate could be dispensed with. The upper edges of the bars are as thin as practicable to reduce the surface to which any amalgam can adhere or pile up on to be carried out of the chute by the moving gravel, and being vertically arranged, permit sinking of the amalgam to the lower part of the receptacle, thus always presenting a clean surface of mercury for the treating of the oncoming material. By thus treating the moving material on a pool of still mercury flouring and loss of mercury is entirely avoided and the grate bars prevent physical loss through splashing from large stones, also prevent large stones from engaging the leaving edge of the receptacle thus insuring their constant downward travel.

To remove the amalgam it is merely necessary to remove the cap from the pipe and take it from the open end of the pipe, and if very thick a few of the bars may be removed and the amalgam pushed out from above. In this connection it is evident that the grate bars may be all secured together like any grate, but if separate as shown it provides for removal or changing around of those most worn.

Where a series of receptacles is used any one at a time may be emptied without stopping the flow of material by simply sliding an iron cover on top of the open chute and allowing the material to pass over it until the receptacle has been emptied and refilled with mercury. Any sand or gravel getting into the receptacle will of course float out again when the receptacle is filled with mercury.

*Rousseau Centrifugal Gold Washer.* Patent No. 1478761. Geo. E. C. Rousseau, inventor. This machine is apparently intended for the concentration of free and base ores only as no mention is made in printed matter of its adaptability to placer operations.

*Savage Fine Gold Saver.* W. B. Savage is listed as having a fine-gold saver for placer gravel. Details are lacking, but can probably be obtained by communicating with Mr. Savage.

*Schaefer Apparatus.* This apparatus consists of a specially prepared 8-inch or 10-inch pipe line and accessories, laid diagonally across a river bed known to carry gold. It is especially suitable below operating mines or at junctions of creeks that bring down gold during heavy rains. The inventor states that installation of this apparatus will not exceed \$2,500 in fairly accessible places and that many locations can be so equipped that not one speck will escape, including 'flour' gold.

*Service Ore Treating and Amalgamating Machine.* This machine is described by the manufacturer as a deslimmer, steam sterilizer, amalgamator, classifier and scourer. It is designed to handle material both mill pulp and placer, minus  $\frac{1}{4}$ -inch mesh.

The method of treatment is given as follows:

"The pulp or ground ore is fed to a hopper in the upper part of the machine from which it is passed to a washing chamber where it receives a scrubbing, from the washing chamber it is passed to a vacuum chamber where the pulp is put under vacuum which causes disintegration to take place, from the vacuum chamber the pulp is passed to the eight steam pressure tubes where it is steam sterilized, scoured, heated, washed with hot water and metallics contained in the pulp ore prepared for amalgamation. The pulp is then passed to a baffle screen where primary classifying is done. It is then passed over a riffle-baffle plate, for spreading and distributing evenly to the mercury bath. The pulp is then passed over a bath of heated mercury where the amalgamation of metals takes place. From here the whole mass is passed to the classifying apparatus where the slimes and

a large part of the gangue is separated from the pulp. The slimes, gangue and classified material all being separated and discharged from the machine at different points. The classifying is done by the use of vacuum and pressure.

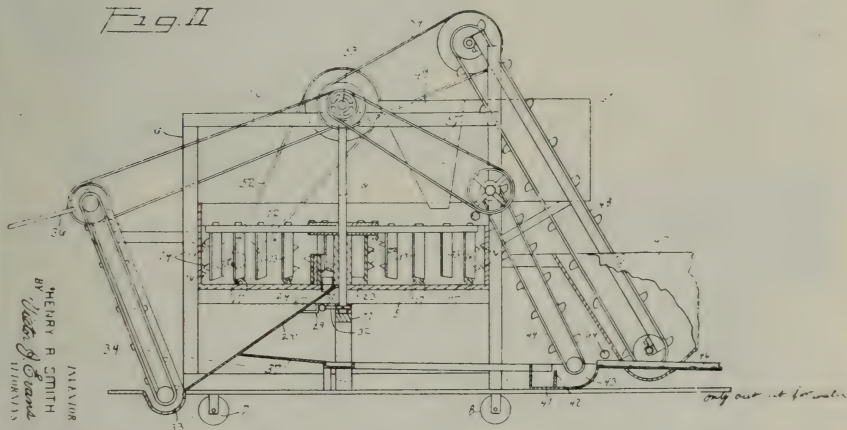
"In the treatment of placer, material is passed through the same as ground ore or lode ores. This machine will amalgamate your finest gold, very coarse gold being caught in the trap on the inside of the machine which is equipped with five of these traps. It will separate gold from black sands where the gold is free, it will separate platinum and osmeridium (sic) from the gold so that the gold can be taken from one chamber and the platinum and osmeridium (sic) from another."

Numerous other claims are made for this machine in a circular, where it is further referred to as "one great combination of brains and science."

*Sherwood Process.* A chemical method of recovering platinum on a small scale from black-sand concentrate has been developed by A. H. Sherwood and used for several years. Logan<sup>1</sup> refers to it as follows:

A. H. Sherwood of Oroville has for several years used a chemical method for recovering platinum on a small scale from black-sand concentrate. His process consists of two stages, (1) putting the mer-

Fig. II



Smith Gold Washer.

cury and platinum in condition to amalgamate, and amalgamating them; (2) separating the amalgamated gold and platinum. A patent has been granted him for the second stage, but not as yet for the initial process. As his rights have not been clearly defined, it is not thought advisable to fully describe the process. It is a new application of a well-known law of chemical solutions, and appears to do all that is claimed for it, giving a beautifully clean platinum and a perfect recovery which would be impossible by purely mechanical means.

The process has not been perfected to the point where it can be used on a large scale, but this is because of the lack of apparatus and not because of any defect in the method.

*Smith Patented Washer*, for treating sand, gravel or clay for the purpose of removing particles of precious metal therefrom. The accompanying drawing shows the main features of the washer. It is

<sup>1</sup> Logan, C. A. Platinum and Allied Metals in California. State Mining Bureau Bulletin No. 85, 1918, p. 98.



mounted on a frame provided with wheels so it may be moved from place to place. According to the patent specifications the operation of the device is as follows:

Assuming that the parts are all arranged in operative position, dirt is placed in the hopper (47), the motor (51) started with the result that this dirt is conveyed upwardly by the conveyor (48) and dumped into the hopper (57). This dirt falls into the tank (5) and is mixed with water from the spray (62) furnished by the tank (61). The paddles (13) in revolving cause the dirt to be agitated and completely broken up so as to be mixed with the water, and as soon as the puddle thus formed reaches a level of the discharge opening (26) it will pass therethrough and into the funnel (27), at which point it will be mixed with more water from the spray (63), and on to the screen (28).

As the shaft (9), which forms the striker, strikes the striker plate (29) thus vibrating the screen (28), dirt which is too large for the screen will pass downwardly and into the trough (33), from which point it will be conveyed away from the machine by the conveyor (34). The material which passes through the screen (28) will fall upon the pan (37) and will wash into the riffles (38) and (39). When this material has reached the end of the riffles the heavier gold will have been cut by the riffles and the mercury contained therein, while the sand and other foreign substances will reach the sump (41) where the settling action will take place. The sand will thus be retained at this point, while the excess water will pass over the partition (42) and into the sump (43).

The conveyor (44) having buckets thereon will return the water from this point back into the tank. There will, of course, be some excess water which will flow over the sluice (46), but the rate of flow will be so slow, that any fine particles of gold will sink and thus be retained.

It will be also noted that a spray (64) is adapted to discharge into the sluice (46) with the result that the slight excess of water flowing thereover will be further diluted, so as to produce practically a clear water, this action resulting in the depositing of the remaining fine gold. In the treatment of black sand, the sliding gate (24) is removed and a lower gate placed therein, because in the treatment of black sand the puddle in the tank should not be over two inches deep.

It will thus be seen that there is provided a concentrator which will handle the coarse, as well as the fine particles, and, that the device might also be employed with other metals.

*Stebbins Dry Concentrators and Separators.* Several types of Stebbins dry tables have been in successful commercial use for over ten years. They are designed to treat free-milling gold ores, lead-silver sulphides and carbonates, copper, chalcopyrite, chalcocite, bornite, placer gold, platinum, tungsten, black sand, and various nonmetallic minerals and byproducts.

The Stebbins dry placer table is used preferably on gravel which has been screened to  $\frac{3}{8}$ -inch or finer but will handle as coarse as 1-inch if required. Black sands are said to be an aid rather than a hindrance. It is delivered as a concentrate in the ordinary course of operations and can be saved for special treatment or discarded as desired. The concentrators will handle feed containing a reasonable amount of moisture,



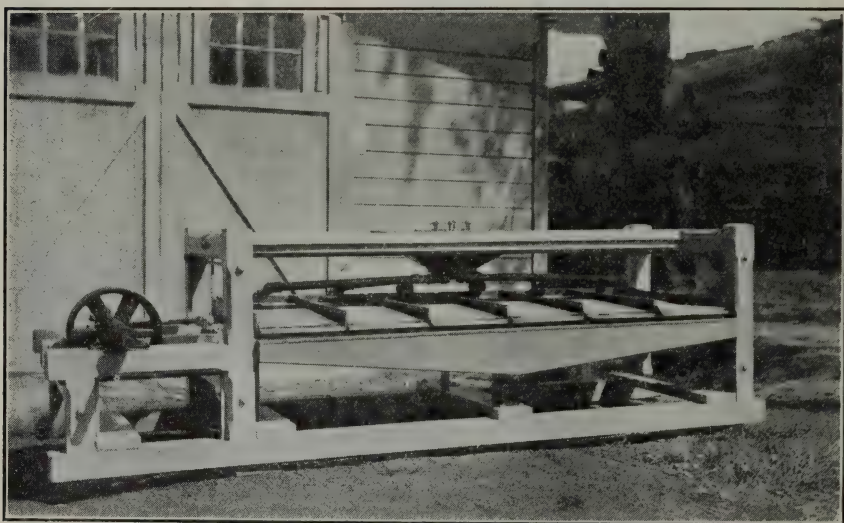


Stebbins Dry Concentrator No. 4.

usually any material that is dry enough to screen. In installations of any size provision is made to control the dust and if it contains values to recover them.

These dry tables have been operated in Arizona, California, Nevada and Mexico and returns from all sizes throughout are said to show a general average of above 90% saving of the gold values in a free state in the gravels. The machines are built to stand up under years of service and being practically automatic in operation require little attention. They are built in a number of models and in sizes from No. 4, having a capacity of 2 tons of screened gravel per hour to No. 12 with a capacity of 25 tons. A recent development is the adoption of the Stebbins machines for the concentration of colemanite and kernite by the Pacific Coast Borax Company.

*Stephens Machine.* This machine which was developed and patented by J. Stephens is featured by a concentrator which eliminates all



Straub Black Sand and Placer Machine. 50-ton size.

amalgamation. It is stated that it will handle 35 yards of gravel per day and that it will collect the very finest particles of gold. It can be operated by 2 men.

*Straub Black Sand and Placer Machine.* This machine consists of from one to six monel metal riffle trays mounted in a frame as shown in the photo (six tray size). These trays are adjustable for slope and are given a rapid transverse movement by an eccentric, adjustable from zero to maximum, on the drive shaft. The latter is driven at 350 r. p. m. This motion causes a boiling action in the pulp or sands between the deep riffles so there is no packing and the fine gold can readily settle through the loose mass of black sand. Mercury may be used if desired but this is seldom necessary as a very high extraction can be obtained by the action of gravity alone.

The capacity of the machine is approximately 8 tons per 24 hours for each tray. Very little power is required, from  $\frac{1}{6}$  to 1 horsepower being

ample. It works well with a small amount of water, the amount of water used within certain limits not perceptibly affecting the recovery. The machine will handle mill pulp or placer sands, the feed recommended being 8 mesh or finer. Trays are removable for cleaning up. The single tray machine weighs about 250 pounds, and the six tray size about 500 pounds making it readily portable.

The U. S. Mint uses this machine in cleaning up and concentrating floor sweepings, ashes, old crushed crucibles etc.

The company also manufacture a general line of mining machinery.

*Struckie Process.* This party claims to have a flour-gold saving process which will recover 99% of the values. No details concerning this process are known to the writer.

*Sutton, Steele and Steele Dry Concentrating Table.* This machine was originally developed for the cleaning of seeds, but it has been adapted to the concentration of finely divided ores and minerals with considerable success. Whether it is suitable for the treatment of heavy black sands seems to be undetermined as yet but it may have possibilities.

Tests made from a total of 84 assays while a carload of concentrates was being turned out on a Sutton, Steele and Steele dry concentrator table at a mill in Utah showed an average recovery of lead contained in heads of 92.77% (galena and lead carbonate ore). Average assay of tails 0.8% lead. Concentrate produced per hour 530 lbs. (all sizes mixed). Heads treated per hour 3181 lbs. (all sizes mixed).

*Taber Amalgamator*, is manufactured by Centripact Machinery Co. No descriptive matter concerning this device is at hand.

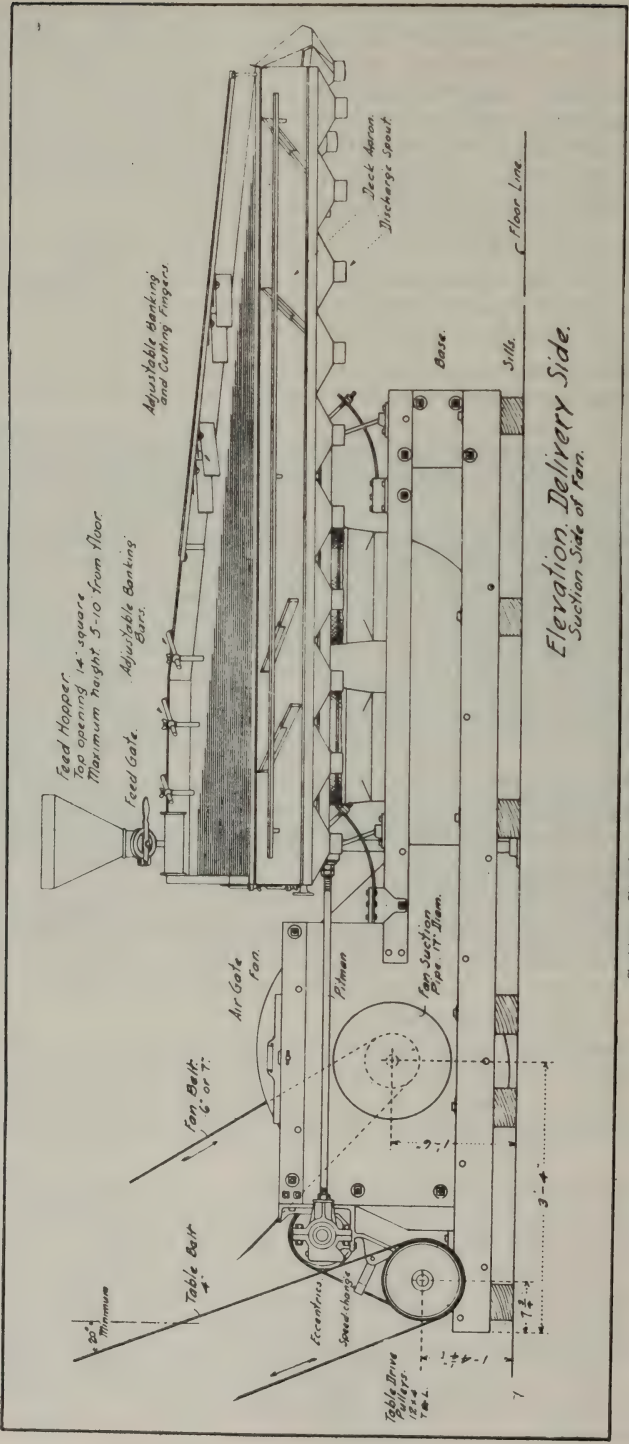
*The Tellam Dry Concentrator*, was formerly put out by the Denver Engineering Works. This company's patterns, drawings and good will have been acquired by the Stearns-Roger Manufacturing Co. but the manufacture and sale of the Tellam dry concentrator has been discontinued by the latter company.

*Victory Riffle-Baffle Amalgamator*, is a shallow flat-bottomed riffle box of special rust and acid proof metal 20 inches wide by 48 inches long, in the twenty-five ton size, and 28 inches wide by 68 inches long in the fifty-ton capacity amalgamator.

Fifteen depressed quicksilver-containing troughs, or pockets, cross it transversely at regular intervals. Suspended over each trough and extending its full length is a metal baffle plate or dam whose lower edge extends down into the trough within a short space of the mercury.

In milling practice the pulp backed up by the first baffle plate, jets down upon the mercury below it. Passing under the baffle plate it rises in an arc and again jets down on the mercury in the second pocket. This action is repeated fifteen times in passing through the amalgamator. It is stated that heavy particles such as platinum or rusty gold that will not amalgamate, nevertheless shoot to the bottom of the quicksilver and remain. For gravel mines, dredging and all forms of placer mining the amalgamator is made in a modified form which it is claimed will save the finest float gold and yet clear itself of black sands.





Sutter, Steele and Steele Dry Concentrating Table.

*Wentz Machine.* This party claims to have a so-called 'dry' placer machine, which uses very little water. Its capacity is said to be 10 to 12 yards in 8 hours. Details are not available.

*Whitten Process.* This process for separating gold from black sand was developed by A. S. Whitten and used at the Rainbow's End Placer Mines. Details concerning the apparatus or method used are not available except from the inventor.

*Windemere Process.* Said to be a new process for saving gold. Further information is lacking but will probably be supplied by the originator.

*Winstanley Amalgamator.* Listed as a fine-gold amalgamator. Nothing is known concerning this machine, but it is presumed details can be obtained from Mr. Winstanley.

#### Notes on Recovery Methods.

Some general information on the recovery of fine gold by amalgamation and additional data on the methods of recovering platinum from concentrates are included herein. These notes are in the main, extracts from an article by Edmund S. Leaver<sup>1</sup> and additional extracts from State Mining Bureau Bulletin No. 85, Platinum and Allied Metals in California, by C. A. Logan<sup>2</sup> now out of print.

#### Checking Gold Content

Experience has shown that in many cases error has been made because the true gold content of a particular sample or deposit was not known. Fire assays of representative samples give accurate results and should be considered final in determining the gold content.

#### Float Gold

The fine gold lost in the usual amalgamation processes is often called float gold. Most of this gold is probably in the form of thin laminae, flattened grains, or scales and its loss is due to noncontact with the mercury. A thinner pulp, provided by the introduction of swinging amalgamated plates as obstructions in the pulp flow and the stirring action caused by more frequent drops onto the different sections of the amalgamation plates has improved the recovery of such gold. Fine gold is readily recoverable by good contact with the amalgamation plates and should not be confused with the gold included in fine sulphides or in other nonamalgamating forms.

#### Rusty Gold

Rusty gold is a term that has been adopted to designate gold which, though apparently free, does not readily amalgamate. It is known that a thin film of sulphur, oxide of iron, silica, grease, or other substances may cover the surface of the gold particle and prevent amalgamation. The film is usually attacked by grinding or some form of abrasion and by the use of alkalies or other chemicals to dissolve the grease.

<sup>1</sup> Leaver, Edmund S., Recovery of fine gold by amalgamation, U. S. Bureau of Mines, Information Circular No. 6081, August, 1928.

<sup>2</sup> Logan, C. A. *op cit.*

## Pyrite

The fine gold which is contained in pyrite does not readily unite with mercury. This gold is mostly recovered with the pyrite concentrate or leached by cyanidation.

## Amalgamation

Silver-plated copper plates are generally used to recover the free gold from ore by amalgamation processes. For best results the plates must be kept as clean as possible. Mercury is worked into the surface of the plates until there is exposed a bright pasty amalgam that readily retains the gold as the ore pulp flows over the surface. To effect amalgamation each particle of gold must come into contact with the mercury; the attempt is made to accomplish this by passing the crushed ore and water in a thin layer over the entire surface of the plates and providing for a drop from each of the plates in the series.

## Effect of Impurities

Good amalgamation conditions are easily reversed by the careless introduction of oils and grease. Soluble sulphides in the ore will darken the mercury and lower the gold recovery. Arsenic and antimony are particularly harmful. Many of the base metals unite with the mercury to form base bullion, or even worse, cause the mercury to slough off and carry away precious metals.

## RECOVERY OF PLATINUM FROM CONCENTRATE

### Hydraulic Mining

The hydraulic miners of most districts have as a rule thrown away platinum for years. Some of them did this because the price obtainable for many years was not considered worth the trouble necessary to get the metal. Others did not know platinum when they saw it, and threw it away with the black sand after amalgamating the gold.

Those who have saved platinum from the hydraulic mines have had only small quantities to deal with and have saved it simply by panning as much of it as they could out of the black sand concentrate left after the gold amalgam was saved. It is hard to get either clean platinum, or to remove all the platinum from the sand by ordinary panning. Better results are obtained if the concentrate is screened and each screen size panned separately for its platinum content. The platinum product shipped by the hydraulic miner is classed as 'crude platinum.' In addition to the native platinum group metals, it contains 1% to 2% of gold and considerable black sand. Even with rather careful work, from 10% to 15% of the 'crude platinum' is composed of impurities without value.

### Dredging

The long tom is in universal use on dredgers to clean up. Sometimes a portion of the platinum is directly recovered in the long tom with the main part of the amalgam, but most of it is in the residual black sand concentrate, which also contains amalgam, rusty gold, scrap iron, and lead. This concentrate is run down to small volume usually in the long tom. The base metals are separated and saved.



They contain some amalgamated gold which is recovered by running the metal into a bar and shipping to buyers, or sending in the accumulated base metal periodically for smelting. The platinum is recovered by panning the final long tom concentrate several times. Its separation from the small amount of gold is easy because it will not amalgamate without special treatment, but the panning is slow and must be carefully done. In many cases the black sand receives no further treatment, but is stored so that it is available for the application of any improved methods of recovering the values remaining in it. This outlines roughly the practice of many dredging companies, but each of the larger companies has its special methods for the treatment of the black sand after the recovery of the main batch of hard amalgam, and these processes will be described.

### Methods Used in Feather River District

At Oroville, the Natomas Consolidated gold man collects the black sand concentrate and amalgam in a box on each dredger and runs it through a long tom till it is reduced to one-half a small water bucket full. The long tom used is one foot wide, twelve feet long and rests on the gold tables so that it has a grade of one inch to a foot. The upper four feet of the long tom are covered with small iron riffles in solid sections one foot long, the cross riffles being an inch apart and sloping back. Below these, the bottom of the box is lined with cocoa matting under expanded metal. From this long tom the concentrate is taken to the clean-up room. The bulk of the amalgam is separated easily and is retorted. The black sand containing platinum and a little amalgam and rusty gold is washed several times in a miniature long tom and the bulk is reduced to about one pint. This contains the gold and platinum group metals. The surplus quicksilver is drawn off, and the concentrate is subjected to a 'boiling' motion, which is imparted by pouring it back and forth between two ordinary crockery bowls. This removes nearly all the black sand. Concentrated nitric acid is applied to remove any base metal and to brighten the rusty gold so that it will amalgamate. The platinum can be finally cleaned by magnet and blower to remove the remaining black sand. All the black sand is saved for future treatment.

Some of the clean-up men at Oroville have made use of the Kellogg black-sand machine to recover the platinum from the long-tom concentrate. (See *ante*.)

Platinum in this district, as well as in the other central California dredging fields, is uniformly fine, either as flakes or grains. It is probable that the best results are not obtained in the ordinary practice where panning and the long tom are used. The pan tubs used by Oroville Dredge, Ltd., gave up after careful final cleaning 12.2% of the annual platinum yield, which had escaped during the monthly clean-ups. How much more platinum remained after this last panning is problematical. The dredging superintendents generally are satisfied with any results which approximate the usual yield of platinum. They reason that the platinum is in such small quantity at best that more careful work is not justified.

### Methods Used in the Yuba River District

Yuba Consolidated Goldfields have devoted considerable attention to the treatment of the black sand concentrate obtained on their dredgers. Their investment in plant and labor for this work is justified when it is remembered that each of their large dredgers gives three tons of sand concentrate a week and a total of 60 to 70 tons of this product is treated monthly. The sand handled is the black sand from the long toms, one of which is used on each dredger to recover as much gold and platinum as can be gotten in a rich concentrate of small bulk. The handling of this residual black sand concentrate does not differ materially from the practice described elsewhere for other properties, but the work done in the sand plant is different from the methods followed elsewhere.

The sand is ground in batches for two hours in a steel ball mill, with a very weak cyanide solution to brighten the rusty gold. The slime is then discharged into a well from which it is pumped into a small settling tank and is subjected to cyanide treatment in a miniature plant which is housed in the same building. Leading from the ball mill is a string of sluices 40 feet long and one foot wide, with a grade of one inch to the foot. This offers the following impediments to the escape of precious metals: (1) Mercury trap; (2) two feet of silvered amalgamating plate; (3) three feet of iron cross-riffles such as are used in long toms; (4) five feet of cocoa matting; (5) eight feet of wooden riffles loaded with mercury; (6) balance of sluice covered with cocoa matting under expanded metal. After drawing off the slime the mill is run open and the sand discharges into this sluice. The process gives about \$40 a ton in gold and platinum. The extraction of gold is said to be nearly perfect, but assays of the sand tailings from the sluices indicate 50¢ to 75¢ a ton in platinum still remaining. In spite of the good recovery, the tailing is not thrown away and the employes are constantly on the watch for any possible improvements in treating it.

Clean-ups made by the Marysville Dredging Company give much finer-sized platinum than that at Hammonton. After the recovery of the hard amalgam in the long tom on the dredger, the black sand is sacked and brought to the clean-up room. It is first run through a long tom 12 feet long which is fitted with iron riffles. Most of the amalgam is saved here. The sand is then rocked in a common rocker. It is next ground in batches of about two buckets for one-half hour in a three-foot arrastre. A little sulphuric acid is used to brighten the rusty gold, most of which is caught in the arrastre. The sand is finally washed through a Colorado amalgamator, which is said to get the remaining values. The concentrate from the long tom, rocker and arrastre is panned three times to get out the platinum.

### Method Used in Natoma District

There is a high percentage of black and rusty gold here in some of the old terrace gravels remote from the present stream. The operating company states that most of the platinum saved is caught in the base trap of the long tom which is used on the dredger to recover hard amalgam and base metals. It is stated that the Neill jigs do not save any platinum, although successful in gold saving. The final recovery

of platinum from the sand is largely in the Senn pan-motion batea. A small Hardinge mill is used to grind the sand. From this mill it passes onto an amalgamated plate two feet wide and ten feet long and thence to the Senn machine. This is operated at 160 r. p. m. The concentrate given is 10% to 30% black sand. The gold is practically all amalgamated on the batea and the platinum is caught in the bowl at the center. This machine was modified according to the ideas of E. E. Strouse, the company's gold man, and the bowl is larger and deeper than on the stock machine. In finally separating the platinum, the batea concentrate is screened. It is found to be much easier to get the platinum from sand of its own screen size, than from sand of all sizes. Some sand stops on a 40-mesh screen; some of the platinum and sand grains are fine enough to pass 100 mesh. The material entering the Hardinge mill carries about \$75 a ton in values, and the tailing from the Senn batea is said to assay \$1 gold and \$1 platinum. If these figures are correct, the process saves 97% of the precious metals.

#### La Grange Method

The Huelsdonk submerged table concentrator has been used here. (See *ante.*)





## ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

**Personnel.**

There have been no changes of personnel to be noted, during the past three months.

**New Publications.**

During the quarterly period covered by this issue, the following publications of the Division of Mines and Mining have been made available for distribution:

Summary of Operations, California Oil Fields, Vol. 13, No. 11, May, 1928, containing a special article on "Long Beach Oil Field."

Commercial Mineral Notes, Nos. 67, 68, 69, October, November, December, 1928, respectively. These "notes" contain the lists of "mineral deposits wanted" and "minerals for sale" issued in the form of a mimeographed sheet, monthly. It is mailed free to those on the mailing list for MINING IN CALIFORNIA.

**Mails and Files.**

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.



## MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

## STATISTICS

## CALIFORNIA'S MINERAL PRODUCTION IN 1928

## Estimate of 1928 Output.

The total value of the mineral production of California for the year 1928, just closed, is conservatively estimated to have been approximately \$353,444,500. This is, in part, detailed in the tabulation below, but, as there are more than fifty mineral substances on California's commercial list, it is impracticable at this early date to obtain definite figures on other than the more important items. The blank report forms are being mailed to the operators in all mineral lines, and the detailed and complete report will be compiled and published later.

The estimated total of \$353,444,500 is a decrease of approximately \$13,300,000 from the value of the 1927 production. The drop is due mainly to petroleum, and in smaller measure to gold, zinc, lead and brick. Although there was a decrease of approximately only 1,000,000 barrels in the quantity of crude oil, the total value will probably show around \$19,000,000 less, owing to lower average prices effective, particularly in the grades above 20° Baumé. Around 85% of the crude oil at present produced in California is above 20° B., some testing as high as 50° B.; while the low-grade ranges down to 9° B. Current prices range from 50¢ per barrel for 14°-20° crude in the San Joaquin Valley fields to \$1.95 for 43° crude in the Athens-Rosecrans-Dominguez section. There was an increase in quantity of natural gas utilized.

Receipts of bullion at the mint and smelters show a decrease in gold yield of about \$800,000 compared with 1927, the drop being chargeable to both the lode mines and the dredges. The drop in silver yield is due to smaller shipments of copper, lead and zinc ores. There was an increased output of about 1000 flasks of quicksilver, and the average price was \$123 compared with \$111.67 in 1927.

Among the structural, industrial and saline groups there were no notable changes to report, with the exception of a decrease in brick and hollow building tile, due to lesser building operations in the cities.

The estimated quantities and values for 1928 are as follows:

\$10,840,000	gold.
880,000	(1,504,000 fine oz.) silver.
3,650,000	(25,000,000 lb.) copper.
102,000	(1,676,000 lb.) lead.
922,500	(7,500 fl.) quicksilver.
375,000	other metals, including iron, manganese, platinum, titanium, tungsten, zinc.
241,500,000	(230,000,000 bbl.) petroleum.
31,000,000	(350,000,000 M cu. ft.) natural gas.
26,000,000	(14,600,000 bbl.) cement.
18,000,000	crushed rock, sand and gravel.
5,000,000	brick and hollow building tile.
575,000	(46,000 tons, crude) magnesite.
1,600,000	other structural materials, including granite, et al.
5,500,000	miscellaneous 'industrial' minerals.
7,500,000	salines, including borates, potash, salt, et al.

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\$353,444,500

## MUSEUM

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

## LABORATORY

FRANK SANBORN, Mineral Technologist

Prospecting for minerals and the exploitation of California's mineral wealth increase rather than decrease as the state becomes more thickly populated. Some of the counties, however, such as Alpine and Mono, are seldom heard from, the reason undoubtedly being that these rugged and sparsely-settled sections have but very few inhabitants, and the itinerant prospector with his burro is now somewhat of a rarity.

In a mineralogical way Alpine is an interesting county. Gold and silver ore of a very high grade have been received from this part of the state during the past year. Some of this ore would apparently be amenable to ordinary milling and cyanidation, but the greater part of it is base and would have to be treated by a smelter. It has been stated that in recent years tests by oil flotation have shown that this process is well suited for some of the ores of Alpine County.

Over 1200 samples were received and determined at the laboratory of this division during the period of three months covered by this report. Selected determinations of possible commercial value, judged from the samples submitted only, are published in each issue of the 'Monthly Commercial Mineral Notes' which is for free distribution, and may be obtained by applying to the Division of Mines and Mining, Ferry Building, San Francisco.



## LIBRARY

SAM P. SENIOR, JR., Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines and Mining contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

## OFFICIAL PUBLICATIONS RECEIVED

## Governmental.

## U. S. Geological Survey:

## Water Supply Papers:

- 591 —Surface Water Supply of the United States, 1924, Part XI, Pacific Slope Basins in California. By N. C. Grover.
- 586 —Surface Water Supply of the United States, 1924, Part VI, Missouri River Basin.
- 588 —Surface Water Supply of the United States, 1924, Part VIII, West Gulf of Mexico Basins.

## Bulletins:

- 806-A—The Pumpkin Buttes Coal Field—Wyoming. By C. H. Wegeman, R. W. Howell, and C. E. Dobbin.

## Hawaiian Volcano Observatory:

- Monthly Bulletins of the, Vol. XV, Nos. 10, 11, 12. (1927) Vol. XVI, Nos. 1, 2, 3, 4, 5. (1928).

Annual Report of the Director of the Geological Survey for the fiscal year ending June 30, 1928.

## U. S. Army:

Annual Report of the Chief of Engineers. Parts I and II, 1928.

## U. S. Coast and Geodetic Survey:

Magnetic Declination in Texas in 1927. Serial No. 417.

Annual Report of the, for the fiscal year ending June 30, 1928.

Report of the Federal Power Commission. Water Powers of California.

## U. S. Bureau of Foreign and Domestic Commerce:

Monthly Summary of Foreign Commerce of the United States.

Part I, July, 1928.

Part II, August, 1928.

Part I, September, 1928.

Part II, September, 1928.

Part I, October, 1928.

#### U. S. Bureau of Mines:

Annual Report of the Director of the Bureau of Mines for the fiscal year ending June 30, 1928.

#### Technical Papers:

- 405 —Analyses of West Virginia Coal.
- 431 —Studies in the Fractional Distillation of Crude Petroleum. By M. B. Cooke and H. P. Rue.
- 432 —A System of Analysis for Oil Field Waters. By C. E. Reistle, Jr., and E. C. Lane.
- 434 —Geophysical Prospecting: Some Electrical Methods. By A. S. Eve, and D. A. Keys.
- 435 —Production of Explosives in the U. S. 1927. By W. W. Adams.
- 428 —A Study of the Less Volatile Oils in Salt Creek (Wyo.) Crude. By H. M. Smith.
- 440 —Measuring the Variation of Ground Resistivity with a Megger. By F. W. Lee.

#### Economic Papers:

- 1 —Summarized Data of Copper Production.

#### Bulletins:

- 265 —Leakage from High Pressure Natural Gas Transmission Lines.
- 276 —Five Hundred Tests of Various Coals in House Heating Boilers.
- 288 —Quarry Accidents in the U. S. 1926.
- 292 —Metal Mine Accidents in the U. S. 1926.

#### Mineral Resources of the United States:

- Gold and Silver in 1926. (General Report.) By J. P. Dunlop.
- Antimony in 1927. By J. W. Furness.
- Abrasive Minerals in 1927.
- Mercury in 1927. By J. W. Furness.
- Coke and By Products in 1926.
- Gold, Silver, Copper, Lead and Zinc in Arizona in 1926. By C. N. Gerry.
- Salt, Bromine and Calcium Chloride in 1927. By A. T. Coons.
- Gypsum in 1927.
- Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1926.
- Gold, Silver, Copper, Lead and Zinc in Colorado in 1926.
- Magnesium and its Compounds in 1927. By J. M. Hill.
- Arsenic, Bismuth, Selenium and Tellurium in 1927.
- Iron Ore, Pig Iron and Steel in 1927. By H. W. Davis.
- Silver, Copper, Lead and Zinc in the Central States in 1927.
- Sand and Gravel in 1927. By E. R. Phillips.
- Platinum and Allied Metals in 1927. By J. M. Hill.
- Bauxite and Aluminum in 1927. By J. M. Hill.
- Feldspar in 1927. By Jefferson Middleton.
- Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1927.
- Potash in 1927. By A. T. Coons.
- Copper in 1926.
- Slate in 1927. By A. T. Coons.
- Gold, Silver, Copper and Lead in South Dakota and Wyoming. 1926.
- Asphalt and Related Bitumens in 1927.
- Silica in 1927.
- Gold, Silver, Copper, Lead and Zinc in Utah in 1926. By C. N. Gerry.

#### Reports of Investigations:

- 2888—Utilization and Prevention of Molybdenum Waste in Oxidized Lead Ore Treatment. By R. E. Head and V. Miller.
- 2889—Observations on Acid Mine Drainage in Western Pennsylvania. By R. D. Leitch.
- 2890—Determining the Air-Flow Resistance of a Small Shaft Mine by Natural Draft. By G. E. McElroy and A. S. Richardson.

- 2891—Official Changes in the Active List of Permissible Explosives for September, 1928.
- 2892—A Visible-Action Continuous-Distillation Apparatus for Laboratory Study of Fractionation. By R. E. Espach.
- 2893—Volumetric and A. P. I. Gravity Changes Due to the Solution of Gas in Crude Oils. By R. V. A. Mills and R. E. Heithecker.
- 2894—The Relations between Specific Volume, Voids, and Size Composition in Systems of Broken Solids of Mixed Sizes. By C. C. Furnas.
- 2895—A Comparison of the Acidity of Waters from some Active and Abandoned Coal Mines. By R. D. Leitch and W. P. Yant.
- 2896—The Production of Magnesia and Silica Crucibles in the Induction Furnace. By C. N. Schuette.
- 2897—Methods of Preparing and Cleaning some Common Heavy Liquids Used in Ore Testing. By R. G. O'Meara and J. B. Clemmer.
- 2898—Ferrous Oxide from Iron and Magnetite. By C. A. Anderson.
- 2899—Determination of Flakiness of Ores. By W. H. Coghill, O. W. Holmes, and A. B. Campbell.
- 2900—Official Changes in the Active List of Permissible Explosives for October, 1928.
- 2901—The Reaction between Magnetite and Ferrous Sulphide. By F. S. Wartman and G. L. Oldright.
- 2902—Preliminary Ore Dressing Tests to Recover Manganese in Rhodochrosite Ores. By F. D. DeVaney and W. H. Coghill.
- 2903—Commercial Possibilities in the Use of Synthetic Hydrocarbon Processes in the Gas Industry. By W. W. Odell.
- 2904—The Flow of Gases Through Beds of Broken Solids. By C. C. Furnas.
- 2905—The Explosibility of Suspensions of Soap Dust in Air. By D. F. Smith and F. A. Hartgen.
- 2906—Preliminary Examination of Low Grade Bauxite with Particular Reference to Flotation. By B. W. Gandrud and F. D. DeVaney.
- 2907—Official Changes in the Active List of Permissible Explosives for December, 1928.

#### Information Circulars:

- 6082—Safeguarding Electrical Equipment Used in Gassy Mines, European Practice: I—Great Britain. By L. C. Ilsley.
- 6083—Are Flame Safety Lamps Suitable for Detecting Petroleum Vapors? By A. B. Hooker, W. P. Yant, and D. H. Zellers.
- 6084—Consumption of Primary or Virgin Tin in the United States, 1927. By J. B. Umbau.
- 6085—Mine Explosions in the United States During the Fiscal Year Ending June 30, 1928. By D. Harrington.
- 6086—Why, When, and How to make Ventilation Surveys of Metal Mines. By G. E. McElroy.
- 6087—Rock Dusting by Hand Method. By D. Harrington and C. W. Owings.
- 6088—The Third Annual West Virginia State Safety Day Meet, Bluefield, W. Va., September 22, 1928. By J. J. Forbes and J. Redyard.
- 6089—Physiological Factors of Mine Ventilation. By R. R. Sayers.
- 6090—How the United States Bureau of Mines Conducts its National or International First Aid Contests. By J. J. Forbes.
- 6091—Recommendations of the Bureau of Mines on Certain Questions of Mine Safety. By the Mine Safety Board.
- 6092—Method and Cost of Mining Magnetite in the Mineville District, New York. By A. M. Cummings.

#### Alabama Geological Survey:

- Monograph 9—Economic Botany of Alabama, Part 2. By R. M. Harper.
- Circular 5—Summary of the Distribution and Occurrence of the Rock-Asphalt Deposits of Alabama. By W. B. Jones.
- Bulletin 34—Statistics of the Mineral Production of Alabama for 1925.

#### California Fish and Game:

- Volume 14, No. 4. October, 1928.

#### Georgia Geological Survey:

- Bulletin 43—Geology of the Tate Quadrangle. By Bayley.



**Idaho Bureau of Mines and Geology :**

Bulletin 13—Craters of the Moon National Monument, Idaho. July, 1928.  
By H. B. Stearns.

Pamphlet 31—Geology and Silver Ore Deposits of the Pend Oreille District.  
By E. Sampson.

**Indiana Department of Conservation :**

The Geology of the Silurian Rocks of Northern Indiana. By E. R. Cummings  
and R. R. Shrock.

Ninth Annual Report of the, 1928.

**Kansas Geological Survey :**

Circular 1—Mineral Resources. Oil and Gas Resources of Kansas in 1927.

**Missouri Bureau of Geology and Mines :**

Vol. XXI—Early Mississippian Formations in Missouri.

**New York State Museum :**

Bulletin 277, September 1928—The Mining and Quarry Industries of New  
York for 1925 and 1926. By D. H. Newland.

**Oklahoma Geological Survey :**

Bulletin 40, Vol. 1.

Bulletin 47.

Circular 17.

**State of Washington, Department of Conservation and Development :**

Bulletin 31—Lead Deposits of the Pend Oreille and Stephens Counties.

**Wisconsin Geological Survey :**

Bulletin 69, Economic Series No. 23—Molding Sands of Wisconsin. By  
D. W. Trainer, Jr.

**Australian Museum :**

Volume XVI, No. 7—Record of the Australian Museum.

Annual Report of the Trustees for the Fiscal Year Ending June 30, 1928.

**Canadian Mining and Metallurgical Institute :**

Bulletin 199, November, 1928.

Bulletin 200, December, 1928.

Bulletin 201, January, 1929.

**Republica Argentina : Minister of Agriculture :**

Publication 37—Datos Geologicos sobre la region de Salagasta.

Publication 38—Los Yacimientos de Mineral de Plomo.

Publication 39—La Sierra de Guasayan Y Sus Alrededore.

Publication 40—Contribucion A. La Geologia de los Departamentos Chical-Co  
Y Puelen.

Publication 42—Estadistica De Petroleo de la Republica Argentina, 1928.

Publication 43—La Mina Aurifera de San Ramon, Departamento de Tupungato,  
Mendoza.

**Brazil Museu Nacional :**

Commemoracao do II Centenario do Cafeeiro no Brasil, Vol. III, No. 4, Dec.  
1927.

Commemoracao do II Centenario do Cafeeiro no Brasil, Vol. IV, No. 2, June,  
1928.

Documentos Historicos, 1648-1672, Vol. 4.

Documentos Historicos, 1648-1661, Vol. 3.

**Canada Department of Mines :**

Diatomite, Its Occurrence, Preparation and Uses. By V. L. Eardley-Wilmot.

**Finlande Commission Geologique :**

Bulletin 83—On Orbicular Granites. By J. J. Sederholm.

**Leidsche Geologische Mededeelingen :**

Deel III. 1928.

**The Philippine Journal of Science :**

Vol. 36, No. 3. July 1928.

- Vol. 37, No. 2. October, 1928.  
 Vol. 36, No. 4. August, 1928.  
 Vol. 37, No. 1. September, 1928.  
 Vol. 37, No. 3. November, 1928.

**Geological Survey of Great Britain :**

- Vol. I, Part 5, *Memoirs of the—Plectambolites and Some Allied Genera.* By O. T. Jones. Nov., 1928.  
 Vol. III, Part 1, *Memoirs of the—The British Carboniferous Producti.* By Helen M. Muir-Wood.  
 Part II—Summary of Progress of the, \* \* \* and the Museum of Practical Geology for the year 1927.  
 The Country Between Wolverhampton and Oakengates.

**Eclogae Geologicae Helvetiae :**

Index Voluminum I-XX.

Mexico—Secretaria de Industria, Comercio y Trabajo : Departamento de Petroleo :  
 Revista Mensual de las Actividades Petroleras en Mexico. Oct. 15, 1928.

**Boletin del Petroleo :**

- Vol. XXV, Num. 6. June, 1928.  
 Vol. XXVI, Num. 1. July, 1928.  
 Vol. XXVI, Num. 2. August, 1928.  
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**Boletin Minero :**

- Tomo XXVI, Num. 1. July, 1928.  
 Tomo XXVI, Num. 2. August, 1928.  
 Tomo XXVI, Num. 3. September, 1928.  
 Tomo XXVI, Num. 4. October, 1928.  
 Tomo XXVI, Num. 5. November, 1928.  
 Tomo XVI, Num. 6. December, 1928.

**State Petroleum Research Institute—Moscow :**

- Notes on Methods of Determination of Pore Spaces in Rocks. By V. A. Silberminz and V. N. Krestovnikov.  
 Notes on the Determination of Alkalies and Their Separation from Sesquioxides. By K. L. Maljaroff.

**Ontario Department of Mines :**

- Bulletin 66—Metal Production of Ontario for the First Nine Months of 1928, with Final Summary of Mineral Output for 1927.

**Polish Ministry of Industry and Commerce in Warsaw :**

- Statistical Data for June, 1928.  
 Statistical Data for July, 1928.  
 Statistical Data for August, 1928.

**Memoires de la Societe Paleontologique Suisse :**

Volumes Publiés : Vol. 1, 1874 to Vol. 47, 1928.

**Imperial University of Tokio :**

- Some Characteristic Features of the Ore Deposits of Japan, Related Genetically to the Late Tertiary Volcanic Activity. By T. Kato.  
 Journal of the, section II, Geology, Mineralogy, Geography, Seismology. Vol. II, parts 6 and 7.

**Java—Leidsche Geologische Mededeelingen.**

Deel III, Aflevering 2, XI. 1928.

**New South Wales : Department of Mines :**

Annual Report of the, for the year 1927.

**South Australia Department of Mines :**

No. 48—Mining Review for the half year ending June 30, 1928.

**New Zealand Geological Survey :**

Memoir No. 1—The Geology of the Malvern Hills.

## Western Australia Geological Survey :

Bulletin 83—Maps and Sections Accompanying the Report on 'The Geology and Mineral Resources of the Northwest, Central and Eastern Divisions.' By H. W. B. Talbot.

## Wellington, Geological Survey Branch :

Extracts from the Annual Report of the Department of Scientific and Industrial Research, 1927-1928.

## University of Birmingham :

Report on the Work of the Department of Oil Engineering and Refining, 1927-1928.

**Societies and Educational Institutions**

## American Geographical Society of New York :

Geographical Review, Oct., 1928.

Vol. XVIII, 1928.

## American Philosophical Society :

Proceedings of the, Vol. LXVII, No. 3. 1928.

## Bureau of Railway News and Statistics, Chicago :

Railway Statistics of the U. S. A. 1927.

## California Academy of Sciences :

Vol. XVII, No. 3, Fourth Series :

A Key to the Species of Eucalyptus Grown in California.

No. 4—Tertiary and Pleistocene Mollusca from the Galapagos Islands. By Wm. H. Dall and W. H. Ochsner.

No. 5—Landshells of the Galapagos Islands. By Wm. H. Dall and W. H. Ochsner.

No. 7—Some Pyramidellidae from the Gulf of California. By Fred Baker, G. D. Hanna, and A. M. Strong.

## Occasional Papers :

XV.

XVI.

No. 1—Notes on Lower Tertiary Deposits of Columbia and their Molluscan and Foraminiferal Fauna. By F. M. Anderson.

No. 2—New Mycetophilidae Taken in California and Alaska. By M. C. Van Duzee.

No. 6—West American Mollusca of the Genus Phasianella. By A. M. Strong.

No. 8—Occurrences of Some Asiatic Birds in Alaska. By H. S. Swarth.

No. 9—A Commensal Polynoid Worm from California. By T. Skogsberg.

No. 10—Structure and Behavior of the Amphipod, *Polycheria Osborni*. By T. Skogsberg and G. H. Vansell.

## Chicago Academy of Sciences :

Vol. 1, No. 4, Oct., 1928, News Bulletin.

## Cleveland Museum of Natural History :

"Dr. Francis Hobart Herrick." Dec. 1, 1928.

## Economic Geology :

Vol. XXIII, No. 7, November, 1928.

Vol. XXIII, No. 8, December, 1928.

## Engineer's Society of Western Pennsylvania :

Vol. 44, No. 6. Proceedings. July, 1928.

Vol. 44, No. 7. October, 1928.

## The Institution of Mining and Metallurgy :

No. 289, October, 1928, Bulletin.

No. 290, November, 1928.

No. 291, December, 1928.

No. 292, January, 1929.



**Journal of the Mineralogical Society of America :**

Vol. 13, No. 11, The American Mineralogist. November, 1928.

Vol. 13, No. 12, December, 1928.

**Journal of the Western Society of Engineers :**

Vol. 33, No. 10, October, 1928.

Vol. 33, No. 11, November, 1928.

Vol. 33, No. 12, December, 1928.

Vol. 34, No. 1, January, 1929.

**Mining and Metallurgical Society of America :**

Bulletin 196—Vol. XXI, No. 4. October–November, 1928.

**The Petroleum Register for 1928.****Annual Report of the Smithsonian Institute for 1927.****University of Missouri :**

Bulletin—February, 1928.

**University of Minnesota Press :**

Catalogue, 1928–1929.

Minnesota Chats, Vol. 10, No. 1, October, 1928.

Minnesota Chats, Vol. 10, No. 2, November, 1928.

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**University of Alabama :**

Bulletin No. 2.

**University of Colorado :**

Geophysical News and Review of Geophysical Literature. By J. H. Wilson.

**University of California :**

Two Foraminiferal Faunules from the Oregon Tertiary. By J. A. Cushman and H. G. Schenck.

Observations on Inclusions in the Granitic Rocks of the Sierra Nevada. By Adolf Pabst.

Basin Range Structure and Stratigraphy of the Warner Range, Northwestern California. By R. J. Russell.

Stratigraphic Relations of Western Oregon Oligocene Formations. By H. G. Schenck.

**Providence Park Museum :**

Trees and Shrubs of Roger Williams Park.

**Library of Congress :**

Report of the Librarian for the Fiscal Year Ending June 30, 1928.

**American Manganese Producers Association :**

Proceedings, September 10–11, 1928.

Annual Report of the Director of the Mint for the year ending June 30, 1928, including Report on the Production of Precious Metals during the calendar year 1927.

**Books.**

Gems and Gem Materials. By Kraus and Holden.

Handbook for Prospectors. By von Bernewitz.

California Blue Book for 1928.

**Maps.**

U. S. G. S. Topographic Maps :

California :

Fresno County :

Delta Farms No. 1 Quadrangle.

Delta Farms No. 3 Quadrangle.

Wheatville Quadrangle.

Deepwell Ranch Quadrangle.

**Kings and Tulare Counties :**

Waukena Quadrangle.  
 Corcoran Quadrangle.  
 Lindsay Quadrangle.  
 Tipton Quadrangle.  
 Woodville Quadrangle.

**Los Angeles County :**

San Pedro Hills Quadrangle.  
 Glendale Quadrangle.

**Idaho :**

Craters of the Moon National Monument Quadrangle.

**North Dakota :**

Minot Quadrangle.

**Utah :**

Gold Hill Quadrangle.

**Hawaii :**

Mauna Loa Quadrangle.  
 Keahole Quadrangle.  
 Hoopuloa Quadrangle.  
 Honaunau Quadrangle.

**Texas :**

Wall Quadrangle.  
 Waldrup Quadrangle.  
 Tankersly Quadrangle.

**Arizona :**

Mohawk Quadrangle.

**Missouri :**

Cardareva Quadrangle.

**U. S. Department of Agriculture, Irrigation Investigations :**

Map of Southern California.  
 Map of Central California.  
 Map of Northern California.

**Great Britain Geological Survey :**

One inch maps England. 77, 137 (solid), 137 (drift), 206, 274, 285, 290, and vertical section 84.

**Current Magazines on File.**

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended :

American Petroleum Institute, New York.  
 Architect and Engineer, San Francisco.  
 Arizona Mining Journal, Phoenix, Arizona.  
 Asbestos, Philadelphia, Pennsylvania.  
 Brick and Clay Record, Chicago.  
 Bulletin, Union Oil Co., Los Angeles.  
 California Journal of Development, San Francisco.  
 Cement, Mill and Quarry, Chicago, Illinois.  
 Chemical-Engineering and Mining Review, Melbourne, Australia.  
 Engineering and Mining Journal, New York.  
 Explosives Engineer, Wilmington, Del.  
 Financial Insurance News, Los Angeles, California.  
 Graphite, Jersey City.  
 Journal of Electricity and Western Industry, San Francisco.  
 Mine and Quarry, Chicago.  
 Mining and Engineering Record, Vancouver, B. C.  
 Mining and Oil Bulletin, Los Angeles.

Oil Age, Los Angeles.  
Oil and Gas Journal, Tulsa, Oklahoma.  
Oil and Gas News, Kansas City.  
Oil News, Galesburg, Illinois.  
Oildom, New York.  
Oil, Paint and Drug Reporter, New York.  
Oil Trade Journal, New York.  
Oil Weekly, Houston, Texas.  
Petroleum Age, New York.  
Petroleum Record, Los Angeles.  
Petroleum World, Los Angeles.  
Queensland Government Mining Journal, Brisbane, Australia.  
Rock Products, Chicago, Illinois.  
Safety News, Industrial Accident Commission, San Francisco.  
Salt Lake Mining Review, Salt Lake City, Utah.  
Southwest Builder and Contractor, Los Angeles.  
Standard Oil Bulletin, San Francisco.  
Stone, New York.  
The Record, Associated Oil Company, San Francisco.  
Through the Ages, Baltimore.

#### Newspapers.

Amador Dispatch, Jackson, California.  
Barstow Printer, Barstow, California.  
Beaumont Gazette, Beaumont, California.  
Calaveras Prospect, San Andreas, California.  
California Miner, San Francisco, California.  
California Oil World, Los Angeles, California.  
Colusa Daily Sun, Colusa, California.  
Daily Commercial News, San Francisco, California.  
Daily Midway Driller, Taft, California.  
Del Norte Triplicate, Crescent City, California.  
Denver Mining Record, Denver, Colorado.  
Exeter Sun, Exeter, California.  
Goldfield News, Goldfield, Nevada.  
Inyo Independent, Independence, California.  
Inyo Register, Bishop, California.  
Ione Valley Echo, Ione, California.  
Mojave Miner, Kingman, Arizona.  
Mountain Messenger, Downieville, California.  
Nevada City Nugget, Nevada City, California.  
Nevada Mining Press, Reno, Nevada.  
Oil Refinery News, Bayonne, New Jersey.  
Palo Verde Valley Times, Blythe, California.  
Placer Herald, Auburn, California.  
Plumas Independent, Quincy, California.  
San Diego News, San Diego, California.  
Shasta Courier, Redding, California.  
Siskiyou News, Yreka, California.  
Sotoyome Scimitar, Healdsburg, California.  
Stockton Record, Stockton, California.  
Tuolumne Prospector, Tuolumne, California.  
Waterford News, Waterford, California.  
Weekly Trinity Journal, Weaverville, California.  
Western Sentinel, Etna Mills, California.



## PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for MINING IN CALIFORNIA.



## EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.







## PUBLICATIONS OF THE DIVISION OF MINES AND MINING

During the past forty-eight years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines and Mining, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines and Mining.

NOTE.—The Division of Mines and Mining frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

### REPORTS

Asterisks (\*\*) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks -----	-----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks-----	-----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks-----	-----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks-----	-----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks-----	-----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks-----	-----
**Part II, 1887, 222 pp., 36 illustrations. William Ireland, Jr.-----	-----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Ireland, Jr. -----	-----

## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
<b>**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Ireland, Jr.</b> -----	-----
<b>**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Ireland, Jr.</b> -----	-----
<b>**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Ireland, Jr.</b> -----	-----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Ireland, Jr.-----	\$1.00
<b>**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford</b> -----	-----
<b>**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford</b> -----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
<b>**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper</b> -----	-----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper-----	.25
<b>**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper</b> -----	-----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
<b>**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper</b> -----	-----
<b>**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:</b>	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
<b>**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper</b> -----	-----
<b>**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper</b> -----	-----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper-----	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper-----	.50
<b>**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper</b> -----	-----
<b>**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:</b>	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50

## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton: 562 pp., 71 illustrations, cloth-----	1.75
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy-----	\$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties-----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties-----	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties-----	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties-----	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo counties, also report on Minaret District, Madera County-----	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island-----	.25
April, 1927, Mines and Mineral Resources of Amador and Solano counties-----	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles counties-----	.25
October, 1927, Mines and Mineral Resources of Mono County-----	.25
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1928, Mines and Mineral Resources of Tuolumne County-----	.25
April, 1928, Mines and Mineral Resources of Mariposa County-----	.25
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties-----	.25
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties-----	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)-----	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919-----	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920-----	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923-----	Free



## REPORTS—Continued

Asterisks (**) indicate the publication is out of print.		Price
January, February, March, April, May, June, July, August, September, October, November, December, 1924-----		Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925-----		Free
January, February, March, April, May, June, July, August, September, October, November, December, 1926-----		Free
January, February, March, April, May, June, July, August, September, October, November, December, 1927-----		Free
January, February, March, April, May, June, July, 1928-----		Free

## BULLETINS

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations-----		
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations-----		
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps-----		
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper. 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)-----		
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations-----		
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations-----		\$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet-----		
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet-----		
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations-----		
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.-----		
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations-----		
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet-----		
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet-----		
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale-----		
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899-----		
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations-----		
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet-----		
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations-----		
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps-----		
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899-----		
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet-----		
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet-----		
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps-----		.50

## BULLETINS—Continued

Asterisks (\*\*) indicate the publication is out of print.

Price

**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps-----	-----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet-----	-----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps-----	-----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet-----	-----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.-----	-----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet-----	-----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps-----	-----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet-----	-----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California-----	-----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps-----	-----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations-----	-----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map-----	-----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet-----	-----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps-----	-----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps-----	-----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.-----	-----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.-----	\$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale-----	-----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.-----	-----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)-----	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.-----	-----

## BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.		Price
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet.	-----	-----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet.	-----	-----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	-----	-----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps.	-----	-----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet.	-----	-----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet.	-----	-----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	-----	-----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet.	-----	-----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet.	-----	-----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps.	-----	-----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	-----	-----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.	-----	-----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	-----	-----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	-----	-----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	-----	-----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	-----	-----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	-----	-----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations.	-----	-----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	-----	\$0.25
**Reconnaissance Geologic Map (of which Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch = 12 miles. Mounted.	-----	-----
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915-16, by R. P. McLaughlin. 278 pp., 26 illustrations.	-----	-----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations.	-----	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper.	-----	-----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper.	-----	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880-1917, by E. S. Boalich. 44 pp., paper.	-----	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth.	-----	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth.	-----	1.00
†Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)	-----	-----
†Bulletin No. 81. Foothill Copper Belt of California. (In preparation)	-----	-----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916-1917 by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth.	-----	-----



## BULLETINS—Continued

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	Price
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## PRELIMINARY REPORTS

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**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.-----	-----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.-----	Free
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper-----	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper-----	Free
**Preliminary Report No. 6. A Review of Mining in California During 1913. Fletcher Hamilton, 1920. 43 pp. Paper-----	-----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper-----	-----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper-----	-----

## MISCELLANEOUS PUBLICATIONS

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**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	-----	-----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	-----	-----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	-----	-----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	-----	-----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	-----	-----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	-----	-----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894.	-----	-----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper.	-----	-----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper.	-----	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	-----	Free

## MAPS

## Register of Mines With Maps.

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**Register of Mines, with Map, Amador County	-----	-----
**Register of Mines, with Map, Butte County	-----	-----
**Register of Mines, with Map, Calaveras County	-----	-----
**Register of Mines, with Map, El Dorado County	-----	-----
**Register of Mines, with Map, Inyo County	-----	-----
**Register of Mines, with Map, Kern County	-----	-----
**Register of Mines, with Map, Lake County	-----	-----
**Register of Mines, with Map, Mariposa County	-----	-----
**Register of Mines, with Map, Nevada County	-----	-----
**Register of Mines, with Map, Placer County	-----	-----
**Register of Mines, with Map, Plumas County	-----	-----
**Register of Mines, with Map, San Bernardino County	-----	-----
**Register of Mines, with Map, San Diego County	-----	-----
Register of Mines, with Map, Santa Barbara County (1906)	-----	\$0.25
**Register of Mines, with Map, Shasta County	-----	-----
**Register of Mines, with Map, Sierra County	-----	-----
**Register of Mines, with Map, Siskiyou County	-----	-----
**Register of Mines, with Map, Trinity County	-----	-----
**Register of Mines, with Map, Tuolumne County	-----	-----
Register of Mines, with Map, Yuba County (1905)	-----	.25
Register of Oil Wells, with Map, Los Angeles City (1906)	-----	.35

## OTHER MAPS

Asterisks (\*\*) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)	-----	-----
**Map of Forest Reserves in California	-----	-----
**Mineral and Relief Map of California	-----	-----
**Map of El Dorado County, Showing Boundaries, National Forests	-----	-----
**Map of Madera County, Showing Boundaries, National Forests	-----	-----
**Map of Placer County, Showing Boundaries, National Forests	-----	-----
**Map of Shasta County, Showing Boundaries, National Forests	-----	-----
**Map of Sierra County, Showing Boundaries, National Forests	-----	-----
**Map of Siskiyou County, Showing Boundaries, National Forests	-----	-----
**Map of Tuolumne County, Showing Boundaries, National Forests	-----	-----

## OTHER MAPS—Continued

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**Map of Mother Lode Region	-----	-----
**Map of Desert Region of Southern California	-----	-----
Map of Minaret District, Madera County	-----	.20
Map of Copper Deposits in California	-----	.05
**Map of Calaveras County	-----	-----
**Map of Plumas County	-----	-----
**Map of Trinity County	-----	-----
**Map of Tuolumne County	-----	-----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	-----	\$0.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	-----	.25
**Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted	-----	-----
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92 (also sold singly) In 4 colors	-----	.50

## OIL FIELD MAPS

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	-----	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	-----	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	-----	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	-----	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	-----	.75
Map No. 6—Salt Lake, Los Angeles County	-----	.75
Map No. 7—Sunset and San Emido and Kern County	-----	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	-----	.75
Map No. 9—North Midway and McKittrick, Kern County	-----	.75
Map No. 10—Belridge and McKittrick, Kern County	-----	.75
Map No. 11—Lost Hills and North Belridge, Kern County	-----	.75
Map No. 12—Devils Den, Kern County	-----	.75
Map No. 13—Kern River, Kern County	-----	.75
Map No. 14—Coalinga, Fresno County	-----	1.00
Map No. 15—Elk Hills, Kern County	-----	.75
Map No. 16—Ventura-Ojai, Ventura County	-----	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	-----	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	-----	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	-----	.75
Map No. 20—Long Beach Oil Field	-----	1.25
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	-----	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	-----	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	-----	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	-----	.75
Map No. 26—Huntington Beach Oil Field	-----	.75
Map No. 27—Santa Fe Springs Oil Field	-----	.75
Map No. 28—Torrance, Los Angeles County	-----	.75
Map No. 29—Dominguez, Los Angeles County	-----	.75
Map No. 30—Rosecrans, Los Angeles County	-----	.75
Map No. 31—Inglewood, Los Angeles County	-----	.75
Map No. 32—Seal Beach, Los Angeles and Orange Counties	-----	.75
Map No. 33—Rincon, Ventura County	-----	.75



## DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines and Mining for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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# Mining in California



April, 1929

PUBLISHED QUARTERLY

STATE OF CALIFORNIA  
DIVISION OF MINES AND MINING

FERRY BUILDING  
SAN FRANCISCO

## DIVISION OF MINES AND MINING

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### EXECUTIVE AND TECHNICAL STAFF

---

WALTER W. BRADLEY

*State Mineralogist*

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C. McK. LAIZURE, District Mining Engineer	-	-	-	-	-	-	San Francisco
W. BURLING TUCKER, District Mining Engineer	-	-	-	-	-	-	Los Angeles
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#### DEPARTMENT OF PETROLEUM AND GAS

R. D. BUSH, State Oil and Gas Supervisor	-	-	-	-	-	-	San Francisco
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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the Division of Mines and Mining, entitled 'Summary of Operations, California Oil Fields.'



STATE OF CALIFORNIA  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF MINES AND MINING  
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY

State Mineralogist

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Vol. 25

APRIL, 1929

No. 2

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CHAPTER OF  
REPORT XXV OF THE STATE  
MINERALOGIST

COVERING  
MINING IN CALIFORNIA

AND THE  
ACTIVITIES OF THE DIVISION OF MINES  
AND MINING





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## PREFACE

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The Division of Mines and Mining (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines and Mining.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines and Mining is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

State of California  
DIVISION OF MINES AND MINING  
WALTER W. BRADLEY  
STATE MINERALOGIST

OUTLINE MAP  
OF  
CALIFORNIA

SCALE



•LEGEND•

- Mining Division Boundaries.
- Mining Division Offices.

MEXICO



## DISTRICT REPORTS OF MINING ENGINEERS

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In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

### New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It was deemed advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

### SACRAMENTO FIELD DIVISION

C. A. LOGAN, Mining Engineer

#### SIERRA COUNTY

#### Geography of Mining Districts.

The western half of the county in which are located practically all of its mines, is a succession of mountain ridges separated by deep canyons in which flow the tributaries of Yuba River. The Middle Fork of this stream forms the southern boundary and the North Fork and its tributaries drain all of the remaining mineral districts. Downieville, the county seat and Sierra City, both early-day mining camps, are in the canyon of the North Fork of Yuba River. The state highway lateral from Nevada City has been completed as far as Downieville, a distance

of 48 miles. The road from Downieville to Sierra City, 13 miles, will soon be widened and rebuilt as a federal road, connecting with the highway built over the Yuba Pass by the federal government. This pass is one of the lowest across the Sierra Nevada and is open, or passable with the aid of tractors, a longer time in the winter than are the other passes. Two railroads touch the extreme eastern side of the country.

Alleghany, the principal mining camp in the county now, is on the ridge between the Middle and North Forks of Yuba River at an elevation of 4700 feet and is 32 miles from Nevada City via the Foote road, or can be reached from Camptonville. This town is in the center of a highly mineralized area of about 14 square miles extending from Oregon Creek on the north to the Middle Fork of Yuba River. The Original Sixteen to One Mine is the principal producer. Attention here is devoted almost entirely to quartz mining now, though the district was originally known for its drift mines.

Downieville is the supply center for numerous drift mining prospects found in the lava covered ridges both north and south of the town. The quartz prospects in the vicinity of the town are small and irregular producers.

Camptonville in Yuba County, near the Sierra County line, supplies numerous drift and hydraulic properties along the ridge between the two forks of the river in the western part of Sierra County.

Sierra City for a long time had several active quartz mines, among them the Sierra Buttes Mine, the largest single producer in the county and one of the largest in the state. Prospecting is again becoming active here both in the quartz mines north of the town and in a few placer mines in the vicinity of Bassett Station. The Yuba Pass marks the eastern boundary of the mining section, and has a few gold quartz and copper prospects.

The northwestern part of the county, from Scales to Table Rock and Gibsonville is almost exclusively a drift mining region. Many prospecting ventures have been under way there the past few years. This section is reached by road from Oroville or Marysville, via Strawberry Valley or La Porte. Scales is 58 miles from Marysville. From Scales to the northwest tip of the county near Gibsonville, a distance of about 12 miles, extends an almost unbroken line of placer locations many of which have been worked out by hydraulicking and drifting, others still containing large bodies of gravel.

#### **Mineral Resources.**

Gold has been and will continue to be the principal mineral product, as the distance from railroad precludes the probability of early development of other minerals in competition with deposits closer to rail lines. Asbestos occurs near Sierra City. Chromite, copper, lead and mineral water have been produced. Iron ore and limestone deposits are known but undeveloped. Molybdenite has been found associated with copper sulfides in prospects in the eastern part of the county, where the rocks are prevailingly granitic.

#### **Power, Water and Timber.**

Alleghany and vicinity is supplied with electric power from a line running from the Alaska Mine at Pike. In the Sierra City district, the

Sierra Buttes mine controls the water supply from a chain of lakes and streams lying to the north of the town and supplying sufficient water for the company's uses and for power for other mines nearby. Downieville has electric power which is limited toward the end of the dry season by a short water supply. Other districts and isolated mines depend upon steam, gasoline or oil engines for power.

Yuba River Power Company has lately been making application to appropriate the unappropriated water in the tributaries of Yuba River and has put one power house in operation at Bullard's Bar, where a large concrete dam was built for the double purpose of restraining hydraulic mine tailing and generating power.

In common with the other counties along the Sierra Nevada, Sierra County has many gravel deposits at rather high elevations, with limited available watersheds and consequently dependent on storm waters and melting snow for hydraulicking, although quartz and drift mines very often develop enough water for their own needs.

There is an abundance of good timber in the various mining districts, the ancient channels in particular usually underlying the inter-stream ridges which carry good stands of pine and fir. This is not an unmixed blessing to the miner, who may find his claims in conflict with the U. S. Forest Service whenever he moves to obtain patent.

#### Maps.

Three maps have been prepared for publication with this report. The principal purpose of these is to show graphically the location of mines and claims. The map of the western half of the county shows the locations of mines by a system of spots and numbers, with an accompanying list of names. This map is intended to show all mines which could be placed with reasonable accuracy, as well as section lines, streams, roads and trails. Two other maps show mines in the Alleghany district and on the ridge between Scales and Howland Flat.

Geo. F. and Ross F. Taylor, Downieville, who assisted in correcting the locations of some mines on the county map, have for sale a very good county map which shows the boundaries of patented land, and which is kept up-to-date. They also have good claim maps for the Alleghany and Downieville districts.

#### Acknowledgment.

The writer wishes to acknowledge the courteous assistance given by owners and operators both during recent field trips and those of previous seasons. Particular thanks are due to Geo. F. Taylor and Ross F. Taylor, County Surveyor and U. S. Mineral Surveyor, Downieville; W. W. Lytzen, Ray Vandervoort and E. O. Carvin, Sierra City; C. A. Bennett, Sixteen to One Mine; F. J. Joubert and F. W. Camp, Camp-tonville, and W. H. Taulman, Scales.



## MINERAL PRODUCTION OF SIERRA COUNTY, 1880-1927

Year	Gold, value	Silver, value	Miscellaneous and unapportioned		
			Amount	Value	Substance
1880	\$974,332	\$576			
1881	950,000	6,000			
1882	1,100,000				
1883	1,075,000				
1884	1,177,349	145			
1885	1,433,881	11			
1886	1,967,152	2,414			
1887	1,502,469	202			
1888	1,250,000	1,500			
1889	1,446,486	1,222			
1890	733,528	2,039			
1891	701,702	811			
1892	688,464	26			
1893	839,343	46			
1894	604,722				
1895	694,470	107			
1896	786,175	424			
1897	370,208	46			
1898	399,063	519			
1899	450,115	359			
1900	659,696	3,463			
1901	575,427	755			
1902	326,155	311	24,000 gals.	\$6,000	Mineral water.
1903	310,770	476			
1904	374,763	1,222			
1905	517,303	3,687			
1906	409,366	2,518			
1907	483,904	2,621	120,000 gals	12,000	Mineral water.
1908	412,626	1,917			
1909	189,672	957			
1910	312,035	1,330			
1911	461,513	5,604			
1912	732,988	2,777	1,285 lbs.	212	Copper.
1913	1,006,573	4,305	9,919 lbs.	446	Lead.
1914	730,000	3,000	2,228 lbs.	98	Lead.
1915	726,362	3,156			
1916	724,256	3,291		1,950	Other minerals.
1917	384,428	1,629	13,031 lbs.	3,558	Copper.
1918	289,368	2,121	807 tons	40,012	Chromite.
1919	301,172	2,957		750	Miscellaneous stone.
1920	442,894	3,967			
1921	612,267	5,236		2,858	Miscellaneous stone.
1922	1,753,242	14,484		2,900	Miscellaneous stone.
1923	878,164	6,134		2,312	Miscellaneous stone.
1924	799,276	5,198		8,000	Miscellaneous stone.
1925	1,373,705	8,919		2	Other minerals.
1926	564,452	2,913		3,677	Miscellaneous stone.
1927	678,873	3,350		2,150	Miscellaneous stone.
				70,300	Miscellaneous stone.
				10	Other minerals.
Totals	\$36,175,709	\$114,745		\$157,235	

## ASBESTOS

*W. W. Casserly.* Goodyear's Bar has two claims a mile from that place near Goodyear's Creek, where an asbestos prospect has been found. Only assessment work has been done.

*Green and Farr Prospect.* E. E. Green and I. J. Farr, owners, Sierra City. There are nine locations, mostly in Sec. 33, T. 20 N., R. 12 E., one-half mile to  $1\frac{1}{2}$  miles south of Sierra City by trail. A wagon bridge across the river would be needed to reach the lowest claim and an old pack trail runs thence up the steep mountainside across the other claims. Blairsden, the nearest railroad point is 19 miles distant on the Western Pacific.

Long slip-fiber amphibole asbestos occurs in schist and serpentine. Samples from the lowest claim near the river show long soft, white

fiber. The work here had reached a depth of only 10 feet when visited in 1928 and the prospect was small. Only assessment work, nowhere deeper than 10 feet, has been done on the claims, although the showing is reported better on other claims, especially on No. 3.

#### CHROMITE

Chromite was mined and shipped from several small properties during the war. The distance from railroad, 30 to 40 miles, resulting in high cost of hauling, would allow operation of chromite mines here only when high prices rule, and there has been no mining of chromite in Sierra County since 1919.

Production came from claims in the vicinity of Forest, Alleghany, Downieville and Sierra City. Belts of serpentine, within which chromite occurs, traverse the county from north to south but are in part covered by later flows of volcanic mud and breccia. The properties that were formerly productive are mentioned in the last county report and in Bulletin 76, published in 1918.

#### COPPER

Remoteness from railroad has discouraged much prospecting or development of the few claims located in this county for copper. A little copper has been noted in the ores of a few mines worked for gold, as mentioned herein under the Empire, Sierra Homestake and others.

Most of the claims taken up in years past were mentioned in Bulletin 50 and in the last county report. These prospects are mostly in the granitic rocks forming the core of the Sierra Nevada, in the eastern part of the county.

#### GOLD (QUARTZ MINES)

The two most important quartz mining districts are those surrounding Sierra City, formerly having several producers, and Alleghany, where most of the gold mined in recent years in this county has been found.

#### Sierra City District

Besides the road connection with Downieville, 13 miles west, Sierra City is connected with the Western Pacific Railroad at Blairsden, 21 miles distant by a road which passes near Gold Lake (elevation about 6500 feet). The road over Yuba Pass connects with Sierra Valley towns to the east.

This district became prominent in the 'fifties' as a quartz mining camp. Sierra Buttes Mine, the largest gold producer in the county, was opened through several adit levels on the southern slope of Sierra Buttes, which rise from the river to a peak 8615 feet high. The Mountain Mine was opened well up on the east slope of the same mountains, the Young America on the north, and several small mines and prospects on the lower south and east slopes.

The Sierra Buttes Mine has amphibolite schist and serpentine on the footwall side and a narrow dike of quartz porphyry, followed farther east by amphibolite, on the hangingwall. The mass of the ridge of which the Sierra Buttes are the culminating peaks, is composed of quartz porphyry or rhyolite porphyry, largely altered to schist, in which the dip and strike of schistosity correspond to those of the neighboring

rock. The rhyolite porphyry and the adjacent and probably older slate, quartzite and limestone of the Calaveras (Carboniferous) on the west, trend north-northwest. In the Calaveras rocks several small mines have been developed such as the Cleveland, Keystone, Primrose, Butcher Ranch and others. The district has been one of milling ores, as distinguished from the specimen ores of the Alleghany district. There has been little work done and little ore found below the horizon of the lower adit levels of Sierra Buttes Mine.

Placer mining operations have never been as extensive here as farther west, although the present stream gravels have been mined and the Pride, Hilda and Thousand and One placer mines are active.

Among the quartz mines in the district on which work was being done in the fall of 1928, were the Sierra Buttes, Young America, Primrose, Cleveland, Kentucky, Bigelow and Monarch.

### Alleghany District

Although the claims now consolidated as the Plumbago, the Rainbow and other mines, had been productive irregularly since the late fifties and the drift mines had been extensively mined even earlier, the later history of the camp as a quartz gold producer began when H. L. Johnson, listening to the tales of old miners who knew of a rich vein that had been crossed in the earlier placer workings, reopened the Tightner upper adit and began producing high grade ore in 1907. For the past 20 years, the mines of the Alleghany district have produced most of the gold mined in the county. The Tightner, Plumbago and Sixteen to One have been the largest producers. The Oriental, Gold Canyon, Kenton and Rainbow were also important, and there were several others that have yielded from a few thousand to several hundred thousand dollars each. In the last six years the Sixteen to One Mine (with which the Tightner is now consolidated), has produced most of the gold credited to Sierra County, and although there has been a great deal of prospecting both in this district and elsewhere in the county, the output from such work has been small. The mines and prospects of the Alleghany district were described in detail by the writer in 'Mining in California' for October, 1922, issued by the California State Mining Bureau, and as that publication is still in stock and is distributed free, it does not seem necessary to repeat the descriptions of individual properties here. The bureau's report on Mineral Resources of Sierra County, published in 1918 is also available. In bulletin 580, U. S. Geological Survey, H. G. Ferguson discussed in detail the geology and mineralogy of the district as revealed then (1915). The areal geology was mapped in the Colfax folio of U. S. Geological Survey, but this is on too small a scale to show many important details. There will be given here a summary of the geology of the district. Alleghany is reached by two roads from Nevada City and one from Camptonville, the shortest being the Foote road from Nevada City, a distance of 32 miles. The town has an elevation of 4700 feet, with considerable snow in winter.

### Geology of Alleghany District

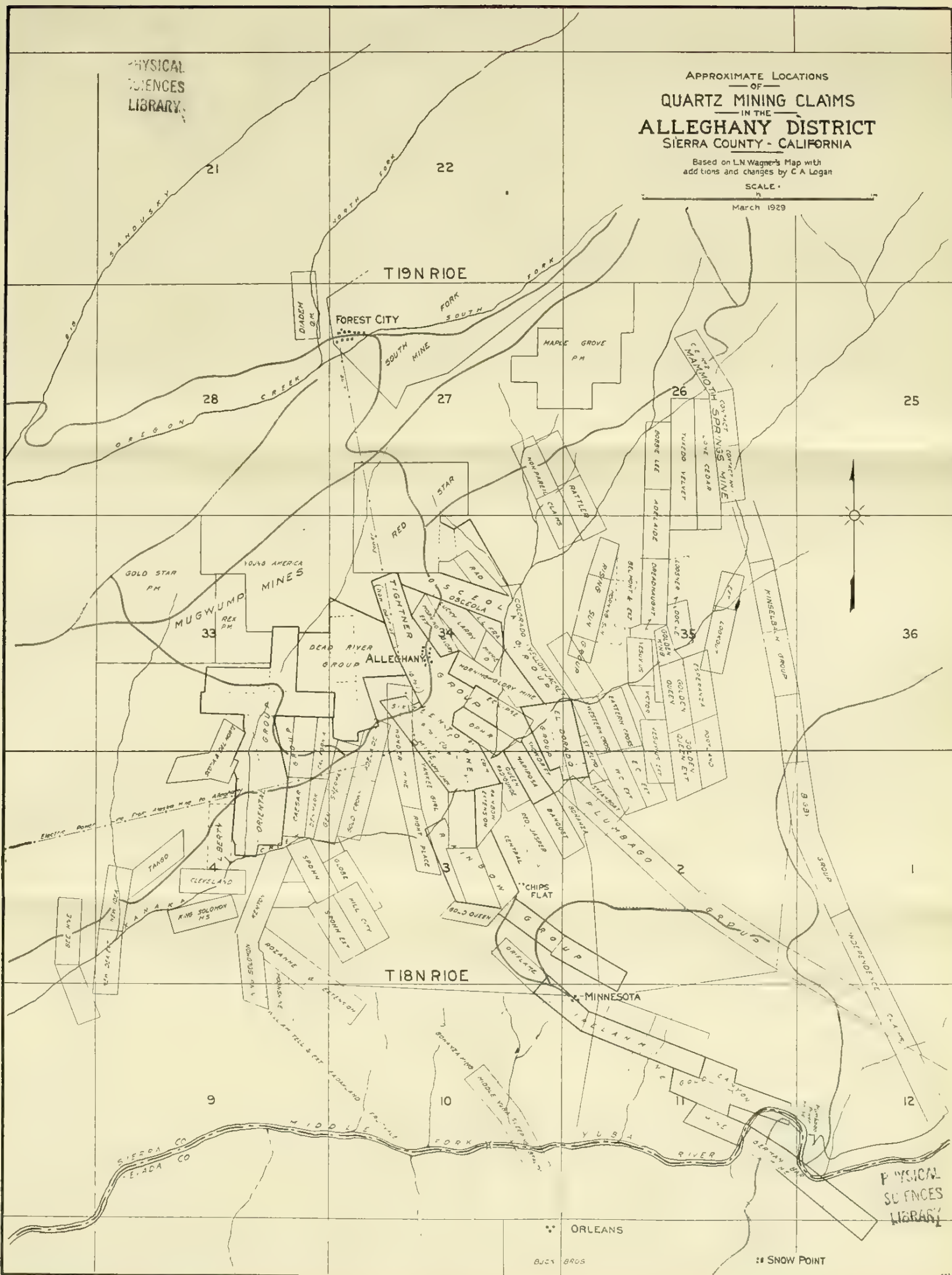
The town of Alleghany is near the southern side of an extensive area of andesite tuff and breccia, through which Kanaka Creek has cut a



Based on L.N. Wagner's Map with  
additions and changes by C A Logan

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deep canyon exposing the older rocks. The Tightner and other vein outcrops were hidden beneath this andesite. Across Kanaka Creek to the south a smaller part of the original andesite covers the extensions of other vein outcrops, including the Plumbago. Many long adits were run 75 years or more ago to work the ancient channels under the lava. The Tightner and Rainbow veins were first cut in these adits.

The oldest of the bedrock series here so far as known, are the Carboniferous rocks. These were originally shale and sandstone, later changed to slate, schist and quartzite, and a very hard, dark flinty rock, more blocky and less schistose than typical slate. These rocks have been tilted and compressed so that they usually dip steeply to the east or northeast and the strike of schistosity is northwest. In places the Mariposa (Jurassic) clay slates were deposited on the Carboniferous, after the latter had been compressed and folded. Both these varieties of rock contain usually small lenses of contemporaneous igneous intrusives. But the great intrusions of igneous rock came later, probably late in the Jurassic or in Early Cretaceous times. Such intrusives picked up and incorporated in their mass fragments and lenses or 'horses' of the earlier rocks. The representative of this varied group in the Alleghany district is amphibolite schist, a grey-green rock derived by pressure from the intrusive gabbro. Here the amphibolite schist and gabbro have a width of  $3\frac{1}{2}$  miles and lie between two belts of the Carboniferous rocks known locally as the Cape Horn slate (on the west) and Blue Canyon formation (on the east). Dikes of peridotite or pyroxenite were intruded into the gabbro and amphibolite and into the contacts between these rocks and the Carboniferous series. Remnants of the unaltered peridotite have been found in the region, from which circumstance it has been concluded that the serpentine found here is derived from peridotite, though it may also be derived from gabbro or other similar intrusives. Of the many varieties of gabbro, available analyses<sup>1</sup> show 45% to 56 %  $\text{SiO}_2$ , 13% to 30%  $\text{Al}_2\text{O}_3$ , 7% to 17%  $\text{CaO}$ , and 2% to 16%  $\text{MgO}$ . Peridoties generally show less silica and alumina, but contain<sup>2</sup> 23% to 48%  $\text{MgO}$ , with only small amounts of  $\text{CaO}$ . It might be expected, then that the alteration of such a series of rocks would give abundant secondary carbonate. This is the case in the Alleghany mines where calcium carbonate is very common, and one of the characteristic wall rocks usually seen is 'bluejay.' This is an aggregate of quartz, dolomitic marble and calcite, of varying composition, often with later veinlets of quartz and calcite. It is colored green by mariposite, a mica which owes its color to chromic oxide, derived undoubtedly from the serpentine and its parent rock, in which rocks alone chromite occurs in any appreciable amount in California. Talc and talcose schist are also common secondary products. The whole series of rocks lying between the two areas of Carboniferous formations, are of types especially susceptible to change by chemical, dynamic and hydrothermal agencies. Frank A. Moss has described the alteration of a similar series of rocks at Carson Hill,<sup>3</sup> Calaveras County, where similar secondary products were formed.

<sup>1</sup> Clarke, F. W., The data of geochemistry: U. S. G. S. Bull. 770, p. 465.

<sup>2</sup> *Idem.* p. 468.

<sup>3</sup> Eng. & Mng. Journal, Vol. 124, No. 26, pp. 1010-1012.



Various observers have noted several different generations of silica in the veins at Alleghany. The miners at the Sixteen to One Mine have noted what they term 'dead quartz' usually low grade in gold content or barren, and 'live quartz,' which makes good ore. The 'live quartz' shows microscopic fractures, recemented by silica, which are absent in the 'dead quartz' or first period deposit.

In a description of the vein at the Irelan Mine written in 1922<sup>1</sup> the present writer mentioned an occurrence where the hanging-wall portion of the vein had been broken into a breccia of quartz fragments up to an inch in thickness. In the north face of what was then the lowest level, this breccia had been cemented together by a greasy looking dark-colored quartz which is thickly filled with crystals of arsenopyrite, from microscopic size to nests of crystals which fill seams one-fourth inch wide. No specimens were seen where the arsenopyrite entered the white quartz fragments, and this would indicate that the arsenopyrite was brought in after the original vein was formed and crushed. This breccia is said to be good ore. It is a good example of the sequence of deposition of the different generations of quartz, which in many cases has to be determined with the microscope. The secondary quartz is without doubt in many places built upon the quartz of the primary veins where the latter were faulted, and where the adjacent wall rock was replaced by ore.

Briefly summarized, some of the conditions thought favorable for deposition of high-grade ore in the district, as observed in past operations, are: Faulting of the low-grade or nearly barren primary vein, as shown by broken and disturbed walls and vein rock, opening channels for later mineralization. Formation of large bodies of secondary carbonate-silicate rocks (dolomite or bluejay), the presence of graphitic materials, and the presence of arsenopyrite are all favorable, as they are active precipitants of gold. Small water-courses, as evidence of permeable or broken formations, are expectantly examined. High grade has been frequently found on either wall outside of what was evidently the main primary vein.

It seems safe to emphasize the importance of faulting in this district in connection with the location of high-grade ore. First, a series of premineral faults occurred after the deposition of the primary quartz veins. Intrusive ore-bearing magma may have caused this faulting and at the same time supplied the valuable minerals, the heat, pressure and chemical agents necessary for the alteration and mineralization. It is easy to believe that postmineral faulting, which broke and opened channels in the original ore deposit may have facilitated secondary enrichment, or may have preceded the deposition of obscure cross veins, with conditions peculiarly favorable for the deposition of their gold content at the places where they crossed the primary veins, the walls of which are so rich in minerals which are active gold precipitants. Confirmatory evidence of the possible correctness of one or both of these theories is found in the disappointing results had in prospecting numerous strong primary veins in the district, and the nearly barren quartz in sections of productive mines, where the primary vein has been little disturbed.

<sup>1</sup> Logan, C. A., Calif. State Min. Bur. Mining in California, Oct. 1922, pp. 506-507.

Some engineers believe that a contact of schist and serpentine is much more favorable for ore deposition on a commercial scale than is a contact of slate and serpentine, and point to examples to prove their case. It is true that the amphibolite schist contains minerals much more susceptible to chemical and hydrothermal alteration than are those in the slate. However, the footwall of the Tightner-Sixteen to One vein from the old surface to 250-ft. level was Carboniferous slate, and if we wish to go beyond the narrow boundaries of the district, we note that many rich ore bodies in this state have been found entirely within the black Carboniferous or Mariposa slates, or in the contacts of these rocks with amphibolite schist or serpentine. The rock series mapped here as slates often contain small dikes, layers of conglomerate and limestone. Besides being weak rocks structurally, the slates contain active precipitants of gold.

*Bessler Mine* adjoins Downieville townsite on the north at the contact of serpentine and Calaveras (Carboniferous) slate. It made some production years ago, then lay idle until 1916, when reopened by the Besslers. It was worked through adits, giving about 150 feet of backs. The Besslers operated in a small way until 1925 under the name of Downieville Gold Mining Company and produced a small amount of gold. In 1925 the Golden Key Mining Company took a lease and option on the claim and held it until the early part of 1928. They produced a small sum. In 1928 the Mutual Security Company took over the lease and are employing four men (March, 1929). The adit work has been stopped and an incline is being sunk on angle of 40°. This was in the black slate and had reached a depth of 70 feet when visited. It is planned to sink 400 feet on the incline.

Equipment includes five light stamps run by water power, an 8" x 6" upright compressor, Fordson tractor, small hoist and gasoline engine, and blacksmith shop.

*Bigelow Mine* adjoins the townsite of Sierra City on the north. A quartz vein striking N. 55° W. and dipping 40° E. shows a width of five feet or more in the lowest workings. It has been prospected by a series of adits driven on the lower slope of Sierra Buttes. These adits have prospected a vertical range of about 250 feet and are connected by a raise 380 feet long on the vein to the surface.

The lowest or No. 2 adit runs northwest on the vein for about 300 feet, when vein is cut off by a fault zone 335 feet wide, occupied by broken and crushed country rock. The adit, continuing on the same general course enters the vein again and follows it to near the face, having a total length of 1350 feet. The vein does not show ore on this level, so far as can be learned. It is a wide, solid quartz ledge with little visible sulphide. The intermediate level, 180 feet above on the dip, is about 400 feet long and a raise has been put up 75 feet above it. Here the vein is narrower and contains considerable sulphide, and evidently small lots of ore were milled from here, but records of the mill runs show its average grade was low. No. 1 adit, 600 feet long, is a crosscut northeast to the vein at a depth of about 50 feet below the outcrop. Morrison Brothers adit, and the gloryhole, both shallow workings, appear to have been the sources of most of the production from the



mine as the ore must have been fairly good to pay for mining and milling under such conditions.

The later work was done by Wm. H. Martin, the late owner. A 10-stamp mill without concentrators, operated by water power was put in operation in September, 1926, but ran only a short time. After his death the property lay idle until the autumn of 1928 when the lessees began work and have lately been crushing some rock.

They closed down after a short period of operation.

*Brush Creek Mine* is near Mountain House on the contact of the slates and the western area of serpentine that passes about three miles west of Alleghany. The old shaft, from which came the high grade ore produced in 1869 and a little later, is on the south side of Mountain House ridge, while the new adit enters on the north in the upper part of the canyon of Woodruff Creek.

In 1922-23, *Ante-Up Mining Company* ran this north adit 2200 feet south and struck the old shaft which is thought to be about 800 feet deep, at about 500-foot level. After sinking a winze 220 feet deep from the adit, they ran in the direction of the ore-shoot and again hit old workings, but produced a few thousand dollars, and later quit.

*Kate Hardy Mining Company* began work here in 1927. They sank the winze 95 feet and crosscut 78 feet to the vein, where they began opening a new level 61 feet below the lowest of the last company's work. When visited late in October, 1928 they reported having drifted 86 feet south with parallel drifts on a vein up to 22 feet wide, from which over 500 cars of ore had been milled with satisfactory results. The vein diminished in width to eight feet at the south face. In the north drift, only 10 feet long, the width of vein is reported 27 feet but the value only \$3.50 a ton. The vein has reversed its dip, now dipping  $58^{\circ}$  to  $82^{\circ}$  east. The hangingwall (east wall) is serpentine and footwall slate. More ore is expected in driving south, as the level above was 275 feet long. Underground work had been stopped temporarily at time of visit as all hands were busy bringing in and erecting a mill, so the mine workings could not be examined.

In March, 1929 the mill of ten 1250 lb. stamps had been erected and is in operation one shift daily, crushing ore which is reported to be yielding about as expected. There is a 10-in. by 12-in. air compressor, boarding house, etc. and electric power has been brought in.

*Butcher Ranch Mine* (formerly the *Van Slyke*) is ten miles north of Sierra City at an elevation of 6500 feet. It was prospected by an adit one-half mile long from which a drift was run 150 feet on the vein showing stringers. Three shafts were sunk, the deepest 150 feet, from which some ore was milled in a mill one-half mile distant. The dump from the drift is said to assay well enough to give promise of ore ahead. There are several patented claims and a mill site, the latter on Butcher Ranch Creek one-half mile or more from the lode claims. This mine is in the Calaveras (Carboniferous) formation only a little east of the narrow serpentine dike which passes just east of the Primrose mine, lying a mile and a half south.

*California Buttes Gold Mining Company* has recently done some work on the *Sacred Mound* and *Buttes Saddle* groups of quartz claims at



Sierra City. The main adit was about 400 feet long, with several crosscuts and raises. A Gibson mill had been installed, but no work was being done in October, 1928, due so it was claimed, to lack of water for power.

*City of Six Mining Company* has the Carson and Carson Extension claims under lease and option to purchase, and holds by location ten other claims at the head of Slug Canyon two miles west of south of Downieville by trail, or six miles by road from Alleghany. The company has been carrying on development work each year during the dry season for a number of years. The Triple Pocket adjoins on the north and the Loosner claim on the south.

The general geologic features are very similar to those noted in the Alleghany district. The same series of rocks occur. The Calaveras (Carboniferous) slate and schist has been intruded by dikes of later igneous rocks which are now serpentine and amphibolite schist. A comparatively small dike of serpentine less than a mile long and a few hundred feet wide, strikes north through the property and is an important feature. The rocks are quite closely folded. The primary vein strikes west of north and dips east at an angle of  $45^{\circ}$  or more, following in part the steeper contact of slate and serpentine, but at places in the slate, numerous quartz stringers run into the slate hanging wall and in places the serpentine of the footwall has been altered by mineralizing solutions which formed dolomite-quartz rock and bluejay.

There has been some faulting of the primary vein by movement in part nearly parallel in dip and strike to the main contact, and the mineralization probably attended or followed soon after this faulting. Gold was deposited in spots in two south-raking zones, one at the Turpin shaft and at a double bend in the vein in No. 2 adit, probably both places being faulted zones.

The development work done up to the end of 1928 included two adits and raises. The upper or No. 2 adit was run as a crosscut 100 feet and then on the vein and contact of serpentine southward for 800 feet. At the main raise to the surface this adit has a depth of about 135 feet on the dip of vein, which averages about  $45^{\circ}$  here. This working starts 200 feet north of the south end-line of the Carson claim and runs south into the Carson Extension claim 600 feet. The lower or Carson adit starts 960 feet north of, and 360 feet lower than the mouth of the upper adit, and runs through the Carson claim into the Carson Extension. This adit is about 1500 feet long, with some crosscuts and is evidently just entering the downward extension of the ore zones mentioned as occurring in the upper level, judging by prospects obtained late in 1928. The operators claim that considerable milling ore has been developed in the upper adit for a length of 600 feet.

The claims have been prospected conservatively, the work previous to 1927 having been done by hand. That year an air compressor and machine drills were installed, but the erection of a mill has very properly been deferred until ore is blocked out in sufficient quantity.

*Cleveland Quartz Mine* is four miles west of Sierra City. It was located in 1886 and worked through a series of adits. A 12-stamp mill, which crushed 17 tons daily, was put up by 1890, and it was worked until the late "90s" by Cleveland Gold Mining Company, and later

by others. In 1915, R. G. Gillespie took an option on it from Costa & Laveroni, and prospected it until 1920, putting in a mill and other expensive equipment, but abandoned it in the latter year, apparently with only nominal production during his operations. The four claims have since been relocated under the name of "Gray Eagle Group" by J. F. Romano who has deeded one-half interest and leased the other one-half to C. E. Patterson. The latter has been working during the summer of 1928 with several men and has cleared and retimbered No. 3 adit for a length of 1650 feet.

According to the Thirteenth Report of State Mineralogist, 1895-1896, the work then was "following the seams of quartz in the slate bedrock, which trend northwest, and swell occasionally to bodies of quartz several feet thick, and carrying in part rich, ochery seams." The No. 3 adit, (the lowest to reach the ore shoots) was 1800 feet long in 1895. It was later extended to 2580 feet. Two ore shoots were worked, the first beginning 750 feet from the portal of this adit and the second 1650 feet in. On the first ore shoot, which had a stope length of 120 to 200 feet and a thickness of one to two feet, a winze was sunk 300 feet below the adit. This shoot has been worked out from surface to the bottom of winze, the total depth being about 750 feet. On the second ore shoot which was also worked out above No. 3 adit, a winze was sunk 130 feet. This ore shoot had a stope length of 100 feet and a thickness of six feet on the 63-ft. level below the adit, but at 130 feet deep had shortened and split into two branches. No. 1 adit 700 feet long is 100 feet deep where it cut the ore shoot; No. 2 adit 700 feet long, is 100 feet deeper, and No. 3 is 280 feet below No. 2. Reports X and XI of the State Mineralogist describe the old mine workings, milling, and ore characteristics in detail.

Patterson Finance Mining and Milling Company was being formed late in 1928 to work the property.

*Colombo (Bullion) Mine* is  $3\frac{1}{2}$  miles by road northwest of Sierra City. The last work, done by Colombo Mines, Incorporated, did not develop any ore, the lower adit not having been advanced far enough, it is said, to reach the ore shoot mined previously in the upper levels.

On October 11, 1928, Dr. John Logan, San Francisco, who alleges that he and others had supplied sums totaling \$100,000 for the use of Colombo Mines, Incorporated in developing this property, caused the arrest of one of the promoters of the company for grand theft, claiming the money had been diverted to other uses.

The mine workings are described in the State Mining Bureau's reports for 1890 and 1918. The ore mined about 1890 averaged \$7 a ton, according to the former report and the total output up to 1918 was reported to be \$365,000.

*Eagle Bird Mine* adjoins the Elcey (Buckingham) Mine nine miles south of east of Downieville to the north of the Henness Pass road. The country rock is granodiorite, just east of the slate contact which passes through the Elcey claims.

It has been prospected by two adits. The upper one is 280 feet long and struck the vein 40 feet from the face at a depth of 90 feet from the surface. One side of the vein was crushed and ran from the surface to the adit level, necessitating breast boards. Because of the good prospects struck in this adit, a second one was started about 100 feet lower.



It is a crosseut 150 feet to the fissure, which was very wet but without quartz; the fissure was followed about 100 feet, but work stopped before ore had been developed.

The Golden Slipper claim adjoining has an adit 80 feet long on a spur vein a few inches wide at right angles to the first vein.

*Edwards Group* of claims is between the Plumbago and Rainbow Mines near Chips Flat. After the work mentioned in the October, 1922 chapter of Mining in California, H. C. Cutting, Piedmont, leased the claims and expended a few thousand dollars upon them without making any production. At present they are idle, Cutting having suspended work on account of a disagreement with Edwards.

*Empire Mine* is two miles southwest of Gold Lake and 16 miles by road from Clio. It is an old property (see Bibliography) which was purchased two years ago by Andrew and Paul Bachels who have since reopened part of the old workings and made some production.

The vein strikes N. 65° E. and dips 50° SE., the walls being partly slate of the Calaveras (Carboniferous) formation and partly igneous intrusive rock. A dike, striking east cuts and faults the vein, and the work done previously has been on one side of the crossing. The old work included adits and shafts. The principal adit is 209 feet below the outcrop and was 700 feet long in 1894, and has not been fully reopened. At 200 feet from its portal a winze was sunk 35 feet and at 300 feet in, a second shaft was sunk and was raised through to the surface, 161 feet above the adit on the dip. The present owners have unwatered it for only 95 feet below the adit and its exact depth is not known, although it was sunk at least to 200 feet below the adit in 1896 and two levels were opened at 100 and 200 feet with drifts on the sulphide ore shoot and with stopes from 100-ft. level to the adit, and above the adit up to the dike. The vein was reported from four to eight feet wide and carried in places as much as 10% low grade sulphides, composed principally of pyrite with a little copper sulphide and galena.

During 1927 and 1928, the owners mined and shipped some of the heavy sulphide ore from 100 feet above the drain adit and 200 feet in. Some ore was also milled and concentrate shipped. A. Bachels reports that the vein prospects for 140 feet east ahead of the old work, and after breaking through the dike he found ore three to four feet wide, so that indications of more ore shoots are good. One of these prospects could be tapped with about 200 feet of backs by a new adit. Some specimen rock was also found. The vein splits going east from the shaft and the work followed the hanging wall side as the footwall branch died out.

In the former operations trouble was experienced in recovering the pay. Two chlorination plants and finally 25 stamps were installed. Ten stamps and one concentrator have been repaired and are in use. Water for power to run the mill and compressor is available at present from the beginning of the spring thaw to some time in July. It has a fall of 210 feet from Willoughby Creek with 1200 feet of ditch and 15-inch to 8-inch pipe line. A steady supply of water could be had from Gold Valley Creek which crosses the property.

*Euclid Group* is one to two miles northeast of Sierra City, on the contact of porphyry and amphibolite schist. The vein striking N. 16° W.



to N. 39° W. and dipping east, has been slightly prospected by a series of short adits. There are five claims and a mill site, covering a length of over one mile, in which distance the vein shows at intervals, as cut in the adits.

*Finney (York) Mine* is on the south side of North Yuba River just west of Downieville. It was formerly a producer of 'high-grade' ore, but has not recently been productive. *Gruss Mining Company* took a long-time lease on the property after its sale under attachment in 1923, and have since been working it irregularly in a small way.

The geologic formations revealed in the present workings are those characteristic of the mines on the Alleghany-Downieville serpentine belt. Only the later adit workings were accessible at time of visit. Here the work is following the contact between the amphibolite schist on the footwall and the Calaveras slate, schist and dikes on the hanging wall. The vein filling varies from a few inches in places to seven feet in width at the face (March 8). The latter width was of the carbonate, quartz and mariposite rock described in the notes on the Alleghany district, with a quartz seam on each wall. There are frequently stringers branching into the wall, but these so far have not carried pay.

Gruss Mining Company ran a drift north 150 feet under the river and south 365 feet from the bottom of the shaft which is 150 feet deep. This did not develop any ore, although the 'high grade' previously mined had come from the upper part of this shaft.

They had also extended the adit to a total length of 1100 feet early in March, 1929. The portal is near the shaft collar, and the direction of adit is south to S. 20° E. It is said to be about 600 feet below the surface at the face. There appeared to be a length of 600 feet or more between the 'high-grade' York shoot at the shaft, and the point in the adit workings where encouraging prospects were obtained. This roused the hope that they were coming into a second ore shoot. Although numerous good prospects and high assays have been obtained since, sufficient to convince the operators that they are justified in continuing work, they had not struck any pockets, and the sections of vein which assay well are not wide enough to make a milling proposition.

Although serpentine is not mapped on the areal geology sheet where this property lies, its presence underground is indicated by the mariposite.

*Four Hills Mine* is near the north county line, seven miles by trail south of Johnsville, Plumas County, at an elevation of 6500 to 7500 feet. There is also an old road, 11 miles long, to the property from Johnsville.

The patented claims extend along the contact of quartz porphyry on the east and the Calaveras formation (Carboniferous) on the west. The immediate walls of the main vein are porphyry and schist and the vein varies from one to 20 feet wide but is generally four to five feet wide. Most of the production has been from 'pockets' or very rich small shoots, followed down from the surface usually less than 50 feet. According to Mac Boyle, 'large bodies (of quartz) seem to be formed by the intersection of veins and stringers with main fissure, and ore is said to be enriched at these points.' According to Wm. Acland Hood, the owner, and Andrew Bachel's, formerly in charge of

the mine work 'high grade occurs where the vein comes in contact with mica schist and where veinlets leave the mica vein and butt against and are cut off by mica schist.'

The mine was first worked by Mexicans and passed through several ownerships before it was taken over by Hood, so there is no complete record of output, which is estimated to have been \$1,000,000 to \$1,500,000. The early day workings were above the drain adit. Later, a vertical shaft was sunk 330 feet deep and a drain adit was run 2500 feet. The adit is a crosscut for 1100 feet striking the main vein 200 feet from the shaft and thence running as a drift on the vein. The adit intersects the shaft at a depth of 150 feet. The principal ore shoot was reported 700 feet long on the first level, where it is said to have milled \$7 a ton and was 200 feet long on the second level, where it assayed \$7 and yielded \$4.50 a ton in the mill. This work was near the shaft. Further east an ore shoot 250 feet long was worked 70 feet above the drain adit and 100 feet below it.

After Hood took the property, little milling or underground exploration was done, attention having been devoted mostly to searching for pockets on and near the surface. During 12 years when Andrew Bachels was superintendent, up to 1926, this work with only two or three men employed, yielded about \$184,000. Two of the largest pockets contained about \$65,000 and \$40,000 respectively. In the course of the work small tonnages of high grade around these pockets was milled. This work was within 40 feet of the surface. The high grade ore contains free gold and considerable pyrite and galena; but the sulphides themselves are not always rich, as they occur in patches elsewhere in the mine with little or no gold. The largest pocket, taken out many years ago, is said to have been worth \$250,000 or more. Silver forms one-fifth to one-sixth of the bullion.

The water of Lower and Upper Spencer Lakes, with combined area of about 29 acres, is used for power development, a fall of 900 feet from Lower Spencer Lake developing 200 h.p. The power house was demolished years ago by a snowslide, and since then compressed air has been used for power, the usual water supply being enough to compress about 900 feet of free air per minute during five months annually. To furnish power for the 20 light stamps, (of which only a part were used lately) air was passed through a steam engine and considerable trouble was experienced by cooling and freezing due to expansion of the air. There is also a drop of 250 feet from Upper to Lower Spencer Lake which could be used to develop power.

The property appears to have possibilities for the development of more ore shoots in depth.

*Gray Eagle (Gold Point) Mine* is six miles east of Downieville and one-half mile north of the road to Sierra City. As originally located it contained 11 claims and 3 mill sites (in 1914), and was equipped with a stamp mill and electric power, with a dam in the river. After considerable development, financial troubles ensued, due it is claimed to the ore not being amenable to ordinary stamp milling. The claims passed to different owners and no work has been done for many years.

In 1928, *Yellow Tiger Mining Company* took the principal claims under option and cleaned out and sampled the workings and dumps. There is an adit 1125 feet long, giving up to 300 feet of backs, and



reported to be on the vein for about 700 feet. About 500 feet from the portal a winze had been sunk 125 feet. According to Gordon Bettles, manager, 150 samples were taken, over widths of three to 50 feet and gave promising assays, indicating a good-sized ore shoot. Only 20% of the gold is free, but Bettles believes the ore is amenable to cyanidation. The company has not fully decided as to future work.

*Great Northern (Mountaineer) Group* comprises four claims adjoining the Young America quartz mine on the north. It is seven miles northeast of Sierra City and 15 miles from Blairsden, the nearest railroad station on Western Pacific Railway.

The claims were worked years ago. A ten-stamp mill was operated and according to the owner the total production has been over \$100,000 from pockets and high grade ore from No. 1 adit, which is 500 feet long. No. 2 adit is 1500 feet long and gives backs of several hundred feet on the main footwall vein.

Several veins, ranging from six inches to six feet in width, occur. The main footwall vein strikes nearly north and dips east. The smaller hangingwall veins which give high assays, strike northeast and dip toward the footwall. Assays range from \$4 a ton for the large veins to \$120 for the small veins. The ore is free milling, yielding high grade concentrates. When formerly operated, 200 inches of water from Deer Lake was taken through six miles of ditch for power, and the owner still claims an ample supply of free water. There is a good stand of timber, and conditions are favorable for cheap operation.

*Kate Hardy Mine*, three miles southwest of Forest, on Oregon Creek, was described in the October, 1922, issue of 'Mining in California.' Work continued there for several years after 1922, but without much production. The main adit was run nearly to the south end-line on the vein. Nearly 2000 feet of work was done below the adit on the 160-ft. and 280-ft. levels. The walls are reported fairly straight in the later workings, without much evidence of faults. In the winze 60 feet below the main adit, the vein is reported faulted west 22 feet and downward 40 feet.

Kate Hardy Mining Company had evidently given up the property, as they were working at the Brush Creek Mine entirely, late in 1928. The Kate Hardy has been quite thoroughly prospected, having been discovered about 1860.

*Kentucky Mine.* This mine is a mile northeast of Sierra City. The owner and his son have developed it after relocating it in 1910. The development, carried on by adits, had been so favorable that the owner was erecting a 5-stamp mill in the fall of 1928, believing that he had sufficient ore in sight of a value of \$6 to \$7 a ton to justify this.

*Keystone Mine* is three miles west of Sierra City, on the steep slope south of Yuba River. It was worked from about 1890 for several years through a series of adits. There are five claims and a mill site. The lowest or Cheney adit is a crosscut for 4000 feet, then was drifted on the vein for 1450 feet at an elevation of 5200 feet. The principal stoping was between this level and the Mead adit level, elevation 5800 feet. According to old maps, one block of ore 600 feet long by 400 feet high, and another 500 feet long by 600 feet high were stoped, the ore being generally one to five feet thick. Stopping began 300 feet



beyond where the Cheney adit struck the vein. There is a winze 42 feet deep below the lower adit near the inner end of the stoped ground.

Equipment includes a 10-stamp mill, rock breaker, cars and water power plant capable of developing about 75 hp. using free water available under 800 feet fall. No work has been done since 1916.

*Monarch Mine* is six miles by road northwest of Sierra City, at an elevation of 6000 to 6500 feet. Little work was done from 1920, when R. G. Gillespie quit the property, until late in the fall of 1928, when it was leased to Dutton, Thompson and others who planned to start soon.

*Monarch Alconda Consolidated Mines*, a Nevada corporation, has lately been formed and it is planned to start retimbering the workings in June. The company expects to open the mine to much greater depth by driving a new adit from Independence Ravine.

Gillespie operated the mine about six years. It was well equipped but much of the equipment was removed later. During his regime the vertical shaft was sunk 332 feet starting in the hanging wall 300 feet from the vein; an adit was run 2700 feet long to the bottom of the shaft and three levels were opened, with the following drifts:

On 100 level, 500 feet north and 200 feet south.

On 200 level, 400 feet north and 300 feet south.

On 332 level, 700 feet north and 500 feet south.

From the 332 level stoping was carried nearly to 200 level. A 20-stamp mill was used for crushing. The geology is briefly described in our 'Mines and Mineral Resources of Sierra County.'

Present equipment includes five stamps, boilers using wood fuel and a compressor.

*Montpelier Mine* at Downieville has been under lease for several years to J. R. Stark who does a small amount of work on the property, employing one or two men.

*North Fork Mining Company*, E. B. Cushman, Secretary, 1024 Mills Building, San Francisco, own 320 acres of mining claims at Forest, including the old Uncle Sam or North Fork drift mine and several quartz claims located on a quartz vein discovered in the gravel workings. The gravel holdings were subleased to Wisconsin North Fork Gravel Mines (which see).

Prospecting began on the ledge in 1910 and a large part of the work done was described in our 'Mines and Mineral Resources of Sierra County,' 1918, pages 131 and 132 (Uncle Sam Mine). The work has consisted of a shaft on an incline of  $14^{\circ}$ , 1037 feet deep and a crosscut 800 feet from the bottom of the shaft to the west rim of the old channel, from which an inclined winze was sunk 300 feet and three levels were turned on which drifting has been done. On No. 1 level the vein with an average width reported to be six feet was followed 120 feet, where it was faulted on north. This vein strikes N.  $20^{\circ}$  W. and dips  $80^{\circ}$  SW. By crosscutting 90 feet, a vein dipping northeast was found. From the bottom level also considerable drifting and crosscutting has been done. The veins vary in width up to eight feet.

The property is supplied with electric power and equipped with an air compressor, machine drills and electrically operated hoist. There is no mill.

Work has been financed for about 15 years by assessments, of which No. 67 was levied in August, 1928.

*Old Mexican Group* of three quartz claims is three miles by trail from Goodyears Bar on the north side of Rock Creek at an elevation of 5000 feet. Quartz from shallow holes on the vein was mined in early days by Mexicans and worked in arrastres. The present owners have run one adit 170 feet with 40 feet of backs, on a vein two to four feet wide, and another adit is now 50 feet long, 40 feet deeper. Very good prospects have been obtained, some of the quartz showing free gold enough to warrant prospecting.

*Oriental Mine* was described in our 'Mining in California,' for October, 1922, and by Ferguson in U. S. G. S. Bulletin 580. Late in 1922, interests connected with *Tonopah Mining Company* began work, planning to prospect the adjoining Dead River Group through the main Oriental adit. Late in 1923, options on the two groups were abandoned after considerable unproductive work.

Shortly after, P. C. Drescher, Gamble, Austin and Wilson began work on the Oriental. Results of their operations were reported disappointing until the present season, when they reported striking an encouraging surface prospect on the opposite side of the serpentine contact from the old workings.

A few thousand tons of low grade ore was milled in the years 1924, 1925 and 1926.

*Pilgrim Mine (American Hill or English American Gold Mining Company)* is at American Hill, seven miles east of Alleghany. It includes the Pilgrim and Pilgrim Annex patented lode claims (47 acres) and the Petticoat and Essex patented placer claims (296 acres) the last two comprising the former American Hill diggings, which are worked out except for about 70 acres on the south end.

The Pilgrim vein strikes N. 18° E. and can be traced about 2000 feet on the surface. The first adit was run 390 feet to the vein which is 18 inches wide, but widens rapidly going north, reaching a width of 18 feet and being of good width for 300 feet, where the vein split and the main branch turns northwest, and decreases to four feet in width, composed of quartz lenses, stringers and slate filling, in a length of 85 feet. It was followed 120 feet further. The ore was pretty well stoped out above this drift. The south drift was run 180 feet from the crosseut, with the vein widening to four feet.

The lower or Patterson adit is only about 20 feet below the older one. It is a crosscut for 500 feet and crossed the vein about 432 feet from the portal, where vein is only a seam. It was drifted on for 88 feet south without widening; on the north, after 100 feet of drifting it increased to six feet and was followed 110 feet further, proving the vein for 350 feet south of the upper workings. The quartz occurs mostly in kidneys.

Two mills were used on the property but because of the lapse of years since work stopped the record of output is not available locally. No sinking has been done below the adits so far as could be learned.

A peculiarity of the vein is the occurrence of carbon at times in small cavities in the white quartz.

The stamps of the last mill lie on the ground and there is no other equipment and little timber on the claims, but plenty of timber nearby. A water right and old ditch with a former capacity of 500 inches belong to the property.

*Plumbago Mine* was described in our 1922 report. In 1923 it was taken under lease and option by *Ante-Up Gold Mining Company*.

The property had previously been opened in later years through an adit called No. 4 level, which was nearly a mile long and is at an elevation of 3819 feet or 700 feet below the outcrop. From a point 2300 feet from the portal of this adit, an inclined winze had also been sunk 650 feet on the vein, which dips  $45^{\circ}$  east, and levels from No. 5 to No. 9 had been run in both directions, the maximum distances explored being 600 feet east on levels 5 and 8 and 760 feet west on level 6.

The lessee sunk the shaft another 100 feet and did only a little drifting. In 1925, *North Star Mines Company* began work on the mine but did little if any new development. No work has been done since 1927. The total production of the property under the various lessees since 1922 has been less than \$200,000.

*Primrose Mine* comprises 11 patented claims covering about two miles in length. The primrose vein strikes north and dips  $80^{\circ}$  W. and is 15 feet or more in width in places. It has not been worked since 1888. The footwall is quartzite and serpentine and hangingwall slate. The old Primrose shaft was 180 feet deep. Two adits from near the old shaft were run nearly 1000 feet, northeast, tapping an old vertical shaft 100 feet deep. One of these adits, only 20 feet deep, was on the Good Hope, a side vein, which is credited with considerable production. The work in later years has been on the De Long vein which strikes N.  $26^{\circ}$  W., and dips east. This vein strikes parallel to the schistosity of the slate and has for a hangingwall at the surface near the workings, a dike of chocolate-colored lava containing brecciated quartz. In the shaft, which is 105 feet deep and was partly filled with water at time of visit, the vein is reported up to 14 feet wide. From the shaft, and drifts only 20 and 25 feet long, the owner says \$18,000 has been produced.

There is a 10-stamp mill, 10 years old, operated by steam power, but there are no concentrators. A new sawmill was being used to saw lumber for buildings in October, 1928, but mining had not been started by the new lessees. There is a steep mountain road to the mine from Sierra City.

*Sierra Buttes Mine* was the largest producer in the county and appears to still have interesting possibilities in some of the upper levels, though there is no ore in No. 9, the lowest level. The previous operations have been described in several publications of the State Mining Bureau (see Bibliography in list of quartz mines, herewith).

In the fall of 1928 W. W. Lytzen, superintendent, had a crew of ten men on prospecting and repair work, on No. 5 and No. 6 levels. On No. 5 they have crosscut into the footwall 300 feet, finding a vein which has an average width of  $4\frac{1}{2}$  feet (maximum width nine feet). They have drifted on this for 700 feet. This level is 350 feet deep, and the



vein found does not outcrop. On No. 6 level, which is about 1000 feet deep on 45° dip and is open for a length of 8000 feet, they have cross-cut to the Whiskey vein and have recently run 100 feet of drift on that vein. They have also been prospecting the Smith vein from the crosscut on this level.

No. 9, the lowest level, is at about the elevation of Sierra City and was run 12,000 feet. It gave a depth of 1800 feet on the dip and was a crosscut for 2000 feet, the balance being drifting on the main or Ariel ledge which is said to break into a number of stringers here and has not been stoped below a point midway between No. 9 and No. 8 level, or 1550 feet deep on the dip. Most of the ore came from above No. 6 level. A longitudinal cross-section of the vein is shown in the Tenth Report of the State Mineralogist. A large tonnage of low-grade ore from the main vein which was six to 20 feet wide, was mixed with rich ore from the Whiskey vein to raise the value of millheads. The concentrate, consisting of pyrite, marcasite and magnetite, was low-grade. The footwall is greenstone and serpentine and hanging wall quartz porphyry. The ore occurred in a series of staggered lenses.

Five stamps of the upper mill, which was burned down some time ago, may be set up below No. 6 level if prospecting warrants. The 40-stamp mill below No. 9 requires repairs and the cyanide plant is in poor shape. The company owns valuable water rights at the two Salmon Lakes, two Sardine Lakes and others nearby and brings water through ditches and flumes, giving 518 feet vertical head, and supplying water for other mines besides their own. The total production of the Sierra Buttes group was \$15,000,000 to \$17,000,000.

*Sierra Homestake Prospect* is six miles northeast of Sierra City on the Sierraville road, and 14 miles from Calpine on the railroad.

A number of adits have been run on Sierra Homestake claim on the steep mountainside south of the North Yuba River. In the highest of these, elevation 5920 feet, a chimney of quartz a few feet long in granite yielded a pocket several years ago which is reported to have contained \$6,000. There is quartz float on this claim at intervals for 1000 feet and beyond the south end-line. It shows a little malachite and leached sulphides. To the west of this line of quartz float, a pure white quartz vein shows a width of 50 feet at the surface. Lower on this same slope a second adit about 75 feet long shows a vein 16 inches wide on the footwall with a side seam eight inches wide. The material on dump shows gold and copper prospects. Thirty feet lower, the dump of an old caved cut or adit shows considerable copper sulphide and carbonate and is said to assay \$4 gold. The next lowest adit, 5800 feet elevation (aneroid) is 140 feet long in granite. The face here shows broken, wet and decomposed granite with quartz from a seam to two feet wide on the footwall side and seams and joint filling across the face. The footwall dips about 45° east and strikes south. This face gives a good gold prospect. The lowest or Gold Tunnel 5740 feet elevation (aneroid) is also 140 feet long. Quartz from a seam to three feet wide extends for about 30 feet on the strike. At the face the footwall vein is about one foot wide. The footwall is straight for 35 feet with a fissure branching into the hangingwall. A small bunch of copper ore was mined here.

On the Copperhead claim north of road a vein two feet wide has been traced 525 feet, striking north. It is in a basic dike of unknown width. At the center of claim, a shaft 30 feet deep on the west end of outcrop shows the vein three feet wide, dipping north. It contains copper sulphides, molybdenite, gold and silver including \$2 a ton in gold.

The owner has a federal power permit for diversion of 10 second feet of water from North Fork Yuba River. There is an old ditch 3400 feet long that could be used, and 2900 feet more including 900 feet of flume is required, as well as a diversion dam. There are a dwelling and storehouse on the claims.

*Sixteen to One Mine* remains the principal gold producer of the county, as it has been for several years. It was described in our 'Mining in California' for October, 1922. In February, 1924, the adjoining Tightner Mine (except the Red Star ground) was purchased at a reported price of \$130,000 and the two properties have since been connected and worked by the *Original Sixteen to One Mining Company*, as they are on the same vein.

The Tightner winze has been sunk by this company from the No. 11 to a point 125 feet below No. 21 level, giving a total vertical depth of about 1030 feet below the collar, or nearly 2000 feet on the dip below the surface. The Sixteen to One winze workings are connected with the Tightner on the No. 11 and No. 13 levels. The vein has been drifted for 1000 feet on No. 11, over 1400 feet on No. 13 and 1200 feet on No. 15 level, but for only short distances below. The extent of work in the two mines previous to October, 1922, was given in detail in October, 1922, issue, referred to above, where many geologic features were also discussed.

Between the 250-ft. and No. 8 levels (the latter being the same as the Twenty-One adit level) and between the former Tightner compromise line and the Sixteen to One main winze, 75% of the vein has been stoped, the usual width worked being six to eight feet. In the Tightner, the vein had been pretty well explored above the No. 6 level for a length of 2400 feet before 1923, and considerable work was subsequently done between No. 6 and No. 11 levels by Alleghany Mining Company. Below No. 8 level, the yield was small. The average amount realized per ton in the Sixteen to One was higher than for any other important mine in the state in recent years, with the exception of California Rand Silver Mine. Average figures for such a mine are, however, misleading and mean little when it is remembered that most of the gold comes from a small tonnage of ore, and the bulk of ore milled is so low grade that it could not be profitably worked alone; milling it, however, permits the recovery of part and at times all of the cost of mining and handling it, which is a necessary part of the systematic search for 'high grade.'

Between No. 8 and No. 11 levels in the Tightner and between corresponding levels in the Sixteen to One, a barren place was found in the vein. The vein in that section varied in width from five to six feet to 14 feet, but neither vein nor walls showed evidence of much movement, except for the ribbon structure which indicated repeated additions to the vein during the period of formation, and small faults



such as one of three feet throw near No. 10 Tightner level. From considerable observation, C. A. Bennett believes the rich ore deposition was associated with pronounced fault zones consisting of a main fault and related smaller faults which have shattered the vein and the hanging-wall and broken what may have once been a continuous ore shoot which is found now as disconnected bunches. The early history of the Tightner operations under Johnson shows that in working the vein through the upper adit (4496 feet elevation) a fault was encountered in sinking and the vein was lost. The lower Tightner adit (present working entry) elevation 4097 feet, was then driven and the vein recovered, it being found that the vein had been displaced 100 feet vertically and 300 feet horizontally, with striations raking  $73^{\circ}$  north from horizontal. Another transverse fault at the 1800-ft. level stepped the east segment of vein down and according to Bennett is parallel to the first Tightner fault mentioned.

The Tightner-Sixteen to One vein system like nearly all productive veins in the district, lies principally in the series mapped as amphibolite schist. In reality, the term amphibolite schist used in mapping and describing rocks in this district and elsewhere in the California gold belt, includes many small lenses and streaks of different rocks. In the mines being discussed, the wall rocks of the vein vary from greenish grey, the typical color of amphibolite schist, to black graphitic schist, the latter probably of the Calaveras (Carboniferous) group or altered basic dikes. The layers of such dark schists and slates, which are often observed as lenses or "horses" in contact with or near the vein, were no doubt caught up and enclosed in the intrusive gabbro from which the amphibolite schist was derived.

The total operating cost including development, mining and milling is reported to be \$6.50 to \$7 a ton. Of this, about three-fourths is the cost of development. The vein is cut up into blocks sufficiently small to avoid missing large bunches of high grade. The most of the gold produced comes from a few tons of this high grade ore, while much of the ore milled ranges in value from \$3 to \$10 a ton and may average too little to repay operating costs. However, under the system of development followed, this rock would be mined and hoisted anyhow. The actual cost of milling it, reported to be 85 cents a ton, is only a fraction of the amount usually recovered from it, which goes a long way toward paying all development costs.

From the crusher, ordinary ore is carried by a belt conveyor to the bin, from which it is fed by another conveyor to a 5-ft. by 4-ft. Hendy ball mill. This carries a load of three tons of balls and revolves 25 r.p.m. It discharges through a screen of .29-inch mesh, the pulp passing first over Hungarian riffles to catch coarse gold, then to a Dorr classifier with a rake speed of 30 r.p.m. and a grade of  $3\frac{1}{2}$  inches per foot. The oversize is carried by bucket elevator back to the mill. The fine pulp, averaging 65% minus 40-mesh, passes over four plates partly covered by corduroy and finally over three sets of Hungarian riffles.

Ninety men are employed of whom 65 work underground.

*South Fork Alleghany Mining Company*, Room 217, No. 704 South Spring Street, Los Angeles, formerly had a lease and option on the *South Fork Group* of claims at Forest. They never carried on any active operations. In 1928 the holdings were reported as transferred



to the United Eastern Mining Company, Los Angeles. The Blue Lead was worked through the property in early days, and our older reports describe the operations.

A number of quartz veins are known on the property and have been held for years by quartz locations over the placer claims but only a little work was ever done on them.

*Tefft Claims.* J. U. Tefft et al., La Porte, owners. Comprise the *Poker Flat quartz claim* and *Grizzly Group* of three quartz claims, the former half a mile from Poker Flat and the latter on the head of Grizzly Creek two miles from Poker Flat.

On the Poker Flat claim, Tefft reports the formations 80 feet wide have been stripped for a length of 400 feet by ground sluicing and cuts. The vein, said to be 15 feet wide is on the contact of serpentine and schist.

On the Grizzly group, a wide vein lying between slate and schist is said to have been opened by six crosscuts in a distance of 800 feet and Tefft states it carries about \$2 a ton in free gold besides concentrates, as a rule, but that he mortars considerable richer rock at times. Water for power is available and timber is nearby. These claims were not visited.

*Willoughby Mine* of four claims, also four later quartz locations and two placer claims, are held by *Gold Basis Mining and Milling Company*, Oakland. The Willoughby adjoins the Empire and was formerly a producer, but the output is not definitely known, and there has been no production for at least ten years past. The past work was through two adits, about 600 and 700 feet long, one of which reached the front vein, on which some stoping was done. Later a shaft was started on the back vein and some ore was found. The veins are parallel and 75 feet to 100 feet apart. An old 10-stamp mill with concentrators was formerly operated on the property.

The present company plans to run a main adit to strike the ledges about 700 feet below the outcrop. Their work has been delayed in part by a dispute over water rights with the owners of the Empire.

*Yellow Jacket and Bear Creek Mine*, comprising two lode claims, lies three-fourths mile east of the Pilgrim Mine at American Hill.

The work has been done principally on the Bear Creek claim. At about the center of the claim, a crosscut was run 125 feet and a drift was run on the vein about 525 feet north and 75 feet south. About 25 feet north of the forks of the drift a winze was sunk which was reported 104 feet deep, but inaccessible at time of visit.

The vein varies from  $1\frac{1}{2}$  to four feet wide, and is of solid quartz and ribbon rock between schist walls (Carboniferous formation). The vein is loose from the walls but has no gouge. Assay returns up to \$10 a ton are reported.

There is a 5-stamp mill on the north end of the Yellow Jacket claim.

TABLE OF QUARTZ MINES AND PROSPECTS, SIERRA COUNTY

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Adelaide	24	21 N.	12 E.	Adelaide Gold Mng. & Mg. Co., Sierra City	6,800		XI, pp. 400-401; XIII, p. 371; M. M. R. Sierra, p. 75
Alaska							See Sierra Alaska Mining Company
Albany Cons. Group	5, 6	18 N.	10 E.	Martin White, Table Rock	3,500	41	M. M. R. Sierra, p. 75
Alhambra				James S. Freeborough, Hartington-Buxton, Derbyshire, England	4,000	40	See Comet-Sovereign
Alhambra Group	10	21 N.	10 E.	Alpha G. Mng. Corp., 100 E. Union st., Pasadena			M. M. R. Sierra, p. 75
Alpha				George G. Morrison, Sierra City			See Comet-Sovereign
American Exchange & Buffalo Gr.	12, 13	20 N.	11 E.	S. E. Martin, Box 57, Klamath Falls, Oregon, 1/2;	6,200	41	VIII, p. 580; M. M. R. Sierra, p. 76
American Flag	32	19 N.	9 E.	J. P. O'Brien, c/o H. Ward Davison, 833 Market st., San Francisco, 3/8; James Grimes, 858 Walker ave., Oakland, 1/8			M. M. R. Sierra, p. 77
Andy Fitz Mng. & Mg. Company	17	19 N.	10 E.	Andy Fitz Mng. & Mg. Co., 512 American Bank Bldg., 1540 San Pablo ave., Oakland	4,000		M. M. R. Sierra, p. 77
Ante Up	17	19 N.	10 E.	See Brush Creek		220	M. M. R. Sierra, p. 77
Ariola & Daneri Cr.	28, 34	20 N.	10 E.	C. W. & Charles Turner, Camptonville. H. Rabe & C. W. Turner, lessees	3,500	20	XII, p. 261; XIII, p. 371; M. M. R. Sierra, p. 77
Atom Group	39	19 N.	9 E.	Marie Phelan, 2303 24th ave., Oakland			
Australia	34, 35	20 N.	10 E.	Bank Mng. Co., 834 Prudential Bldg., Buffalo, N. Y.	4,200	80	M. M. R. Sierra, p. 77
Bank Mining Company	1	18 N.	9 E.	Luke Bannister			M. M. R. Sierra, p. 78
Bannister	2	19 N.	10 E.	L. & T. Bessler, Downieville, Mutual Security Co.; A. D. Frumento, Mer., Downieville, operating	3,500		See Bonanza
Banquet				Bigelow Mng. Co., Mrs. Elizabeth Martin, Nevada City, owner. E. L. Blanton et al., lessees	4,400	103	XX, p. 18
Bessler	26	20 N.	10 E.	Big Avalanche Mng. Co., Inc., S. A. Snell, Secy., 170 6th st., San Francisco			XI, p. 413; XII, p. 262; XIII, p. 371; M. M. R. Sierra, p. 78; XVIII, p. 737
Bigelow	28	20 N.	12 E.	Mrs. L. C. Harden & Peter Flowers		400	
Big Avalanche Group	5, 6	19 N.	12 E.	Deforest Brothers, 30 Broad st., New York			XVII, p. 471; XVIII, p. 502
	31, 32	20 N.	12 E.	H. J. Gould, Downieville	5,400		M. M. R. Sierra, p. 78
Belmont	35	19 N.	10 E.	H. H. Bates, B. F. Marsh, Sierra City			M. M. R. Sierra, p. 78
Black Jack	16	19 N.	11 E.	John Avignoni, Sierra City	4,300		M. M. R. Sierra, p. 79
Black Warrior	22	20 N.	10 E.				See Mountain Mine
Blue Bird							
Boliva	31	20 N.	12 E.				
Bonanza							

Bonanza.....	17, 20	19 N.	10 E.	Frank R. Wehe, Emma Cole et al, 74 New Montgomery st., San Francisco.	4,500	105	See Edwards Group M. M. R. Sierra, p. 79; XVIII, p. 502; XX, p. 17
Brush Creek.....	18, 19	19 N.	10 E.	Mng. Co., 411 B st., Santa Rosa			
Buckeye Cons.....	Loganville	Dis t.		R. B. Young, Portola.....			See Elcy Mine
Buckingham.....							See American Exchange & Buffalo XI, p. 401; XIII, p. 373
Buffalo.....	24	21 N.	12 E.	F. J. Cook, Sierra City; J. Spaulding, S. V. & Leon	7,100		
Bull of the Woods.....	30	20 N.	12 E.	Heintzen, Browns Valley. Lease & option to	5,000	150	X, pp. 648-649; XII, p. 374; XIII, p. 374; M. M. R. Sierra, p. 79
Bullion (Colombo).....				Columbo Mines, Inc., Dr. John Logan, 198			
				Haight st., San Francisco & Dr. George Mac-			
				Nevin, 576 13th ave., San Francisco; A. E.			
				Hammond, box 115, Nevada City et al.			
Bullion & El Dorado.....	21	20 N.	12 E.	Lessee, Calif. Buttes Mng. Co., Sierra City	8,000	33	See El Dorado
Buttes Saddle.....	1, 11	20 N.	11 E.	M. H. Miller, 2313½ Q st., Sacramento.....	6,500	74	X, p. 653; XI, p. 416; XIII, p. 373 M. M. R. Sierra, p. 80
Butcher Ranch.....	12	20 N.	11 E.				
Cedar & Baltimore (see Rising Sun also).....	35	19 N.	10 E.	T. Z. Blakeman. Leased 1922 to F. W. Nicholls, Allegany		23	XII, p. 263; XIII, p. 374; M. M. R. Sierra, p. 81; XVIII, pp. 513-514
Chips.....							See Swastika Mng. Co.
City of Six.....	2	19 N.	10 E.	City of Six Mng. Co., A. E. Hodgkinson, Secy., 302 Lane Mortgage Bldg., Los Angeles, lessee			M. M. R. Sierra, p. 81; XVII, p. 474; XVIII, p. 737; XX, p. 18
Cleveland.....	4	18 N.	10 E.	A. L. House, 304 Kohl Bldg., San Francisco.....	3,500	20	X, pp. 650-652; XI, p. 414; XIII, p. 374; M. M. R. Sierra, p. 81
Cleveland.....	35	20 N.	11 E.	C. E. Patterson, 638 21st st., Oakland, ½; J. F. Romano, ½	4,250	80	M. M. R. Sierra, p. 81; XVII, p. 474
Colorado-Yellow Jacket (see Oscola Gr., also).....	34	19 N.	10 E.	Estate of R. G. Gillespie; B. F. Stewart, Jr., Admr., 2655 Wakefield ave., Oakland	4,500	60	M. M. R. Sierra, p. 81; XVIII, pp. 511-512
Columbo.....	17	19 N.	11 E.	Sovereign-Comet G. Mng. Co., F. O. Richardson, Mgt., Downieville	5,500	220	See Bullion XI, p. 404; XVII, p. 474
Comet.....	24	20 N.	11 E.	Sierra Gold Mng. Co., Geo. Wood, Secy., Room 7, Grant Bldg., Richmond		100	XVIII, p. 502, XX, p. 17
Sovereign.....				Continental Mng. Co., B. B. Lewis, Alleghany	4,500		M. M. R. Sierra, p. 82
Contact Group.....	26	19 N.	10 E.	S. Stephenson, Sierra City.....	4,750		M. M. R. Sierra, p. 82
Continental.....	36	20 N.	11 E.				
Dayton Cons. Group.....				Stanley Weiland, Scranton, Pa. Dead River G. Mng. Co., Alleghany	4,600	a 100	XVIII, pp. 502-503
Dead River Gr. (see under placer also).....	33, 34	19 N.	10 E.				

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TABLE OF QUARTZ MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Deer Lake et al.				Mary W. Peck, 1461 Carrol ave., Los Angeles.			
Del Norte & Scotia	4	18 N.	10 E.	E. L. Crafts, Forest City	4,500	30	M. M. R. Sierra, p. 82
	33	19 N.	10 E.				
De Luxe				Jesse Darnell Agt., 132 Cooper ave., Yuba City.			See Granger
Diadem	28	19 N.	10 E.	Est. of J. M. Harper, R. B. Harper, Admr., 74 New Montgomery st., San Francisco	4,700		M. M. R. Sierra, p. 82
Dixie et al.				H. E. Nieman, Vader, Wash.			
Docile	35	19 N.	10 E.	Edwin E. Smith, 71 First st., San Francisco.	4,500	11	XII, p. 264; XIII, p. 375; M. M. R. Sierra, pp. 82-83; XVIII, p. 503 See Lonesome Pine
Dolly Varden				R. D. Dorris, Forest.			
Dorris Group	29, 31	19 N.	10 E.				
	32	19 N.	10 E.				
	35	19 N.	10 E.	Evan R. Jones & Owen T. Owen, Forest.	4,400	25	XII, p. 264; XIII, p. 375; M. M. R. Sierra, p. 83; XVIII, p. 503
Dreadnaught						113	
Dudley	21, 22	20 N.	12 E.	Margaret Dudley, c/o Christine H. Kenyon, Agt., Springville			
	27	20 N.	12 E.	Durston Gold Mng. Co., 903 Merchants National Bank Bldg., San Francisco			
	3, 4	18 N.	10 E.				
Durston Gold Mng. Co.				M. H. Miller, 2313½ Q st., Sacramento, et al.	6,000	20	M. M. R. Sierra, p. 83
Eagle Bird				Bonded to C. A. Jackson.			
Eastern Star	9	19 N.	11 E.	Robt. Foster, Latrobe			M. M. R. Sierra, p. 84
Eclipse Cons.				Original 16 to 1 Mng. Co., ½; Ophir Mine, ½	4,000		XIII, p. 375; XVIII, p. 511
Eclipse	34	19 N.	10 E.				
A. W. Edwards Group (see Gold Lake or Glidden)	10, 15	21 N.	12 E.	A. W. Edwards			See Gold Lake
E. Edwards Group	2, 3	18 N.	3 E.	E. Edwards, Alleghany			XVIII, p. 503; XX, p. 17
Eighty-Nine				George W. Cox, 2955 Clarendon ave., Berkeley			M. M. R. Sierra, p. 84
Eley	9	19 N.	11 E.	Est. of J. L. Buckingham, Downieville; M. S. Hamilton, Plaza Bldg., Oakland, Agent	5,000	40	M. M. R. Sierra, p. 84
				Fessler Estate, Alleghany			
El Dorado	34, 35	18 N.	10 E.		4,000		XI, p. 407; XII, p. 262; XIII, pp. 372-373; M. M. R. Sierra, pp. 85-86 XVIII, pp. 503-505
Elkton Clms.				J. E. Middagh, Downieville, et al.			
Emerald	Head of Rock	Cr.		D. W. Smith & Wm. Shipsey			M. M. R. Sierra, p. 86
	9	19 N.	11 E.				
Empire Group (Gold Valley)	25, 26	21 N.	11 E.	A. & P. Bachelis, Goodyear Bar, owners.	6,000	104	XII, p. 265; XIII, pp. 376-377; M. M. R. Sierra, p. 86

English-American G. Mng. Co.	29	19 N.	11 E.	157 E. Eighty-first st., New York City (address uncertain)	343	See Pilgrim
Euclid Cr.	21, 22	20 N.	12 E.	Margaret H. Dudley, 2655 Wakefield ave., Oakland	105	
Faith.	Nr. Hoiland	Flat		Frank T. Wehrle, 795 Gray st., Oroville		
F. & F. Group	28, 29	19 N.	10 E.	James Finan, Forest & O. H. Fuller, Grass Valley	4,500	M. M. R. Sierra, p. 86
	30	19 N.	10 E.			
Federal	27	19 N.	10 E.	Federal Mng. Co., Nevada City; J. M. Harper, Pres., Fairmont; J. W. O'Neil, Secy., Nevada City	120	M. M. R. Sierra, p. 86
Fessler						See El Dorado
Finney	35	20 N.	10 E.	Gross Mng. Co., 333 Kearny st., San Francisco, lessee	3,000	M. M. R. Sierra, p. 133; XX, p. 18
Forest Queen	21	21 N.	12 E.	L. B. Chenoweth, Quincy, et al.		M. M. R. Sierra, p. 86
Four Hills	2, 9	21 N.	11 E.	Wm. Adland Hood, Sequoia Apts., Berkeley	749	XIII, p. 293; M. M. R. Sierra, pp. 87-88
	10, 11	21 N.	11 E.			
Fruitvale & E. Oakland						See Andy Fitz
Gabland	7	19 N.	12 E.	Mitchner Mng. Co., Harry Mitchner, San Francisco		M. M. R. Sierra, p. 88
Garibaldi						
General Grant	36	21 N.	11 E.	Elam Biggs, Grass Valley	36	XIII, p. 376; M. M. R. Sierra, p. 88
Glidden	19	18 N.	9 E.			M. M. R. Sierra, p. 88
						See Gold Lake Claim
Gold Basis	25	21	11	Gold Basis M. & M. Co., 1608 Webster st., Oakland		See Willoughby
Gold Bluff	23, 26	20 N.	10 E.	John Rosenfeld's Sons, 1024 Merchants Exchange, San Francisco	110	XII, p. 266; XIII, p. 376; M. M. R. Sierra, p. 110
	2, 3	19 N.	10 E.			
Gold Canyon	11	18 N.	10 E.	Mrs. C. Hill, 1950 Jones st., San Francisco	72	M. M. R. Sierra, pp. 89-90; XVIII, p. 505; XX, p. 17
Golden Fraction	4	18 N.	10 E.	E. Carlson, Supt.		M. M. R. Sierra, p. 90
Golden King	35	19 N.	10 E.	Golden King Mng. Co., 118 California st., San Francisco	40	XI, p. 417; XII, p. 266; XIII, pp. 377-378; M. M. R. Sierra, p. 90; XVIII, p. 505
Golden Link	On Saw mill	Ridge		J. H. Beckman, 916½ J st., Sacramento		XIII, p. 378
Golden Star	36	20 N.	10 E.		3,825	
Gold King	5	18 N.	10 E.	Marie H. Weldon, W. P. Weldon, 620 Shattuck ave., Taft	4,000	M. M. R. Sierra, p. 90; XVIII, p. 505
Gold Lake (Glidden or A. W. Edwards Group)	15	21 N.	12 E.	Arthur Edwards, Prescott, Arizona	6,800	XII, p. 266; XIII, p. 376; M. M. R. Sierra, p. 84
						See Gray Eagle
Gold Point						See Minnesota Dev. Group
Gold & Silver Mng. Co.						See Empire Group
Gold Valley						
Gourley				Anna B. Gourley, 3035 Deakin st., Berkeley		
Granger		22 N.	10 E.	Jess Darnell, Agt., 132 Cooper ave., Yuba City		XVIII, pp. 503-506

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TABLE OF QUARTZ MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Grant & Apple.....				W. A. Derrer, 3540 Downing ave., Glendale.....			XL, p. 408; See Mariposa; XVIII, p. 508
Gray Eagle.....				D. F. Sullivan, et al., Downieville, owners; Yellow Tiger Mng. Co., lessee.....	3,800		See Cleveland
Gray Eagle (Gold Point).....	28	20 N.	11 E.	Thomas Rose, Camptonville.....			M. M. R. Sierra, p. 91
Graphic.....				G. Scott, Downieville.....			M. M. R. Sierra, p. 91
Great Northern.....	5	20 N.	12 E.	S. C. Hain, box 426, Tres Pinos.....	6,100	82	See Mountaineer
Hain Group.....				Hansen Bros., Sierra City.....			
Hansen Bros.....		Head of Howard Cr.		Henry Hartman.....			See King Cons. Gr.
Hartman.....				John A. & Annie Reid, Downieville.....			M. M. R. Sierra, p. 91
High Commission.....	25, 26	20 N.	10 E.	Sierra Highland Mng. Co., 401 Claus Spreckels Bldg., San Francisco.....	5,000	50	M. M. R. Sierra, pp. 91-92
Highland.....				Mrs. B. Haskell, General Delivery, Oakland.....			
Homestake.....	9	19 N.	10 E.	W. A. Derrer, 3540 Downing ave., Glendale.....	5,600		M. M. R. Sierra, p. 92
Hope.....							See Minnesota Dev. Group
Humming Bird.....							M. M. R. Sierra, p. 92
Ina.....							See Sierra Buttes
Independence.....	12	18 N.	10 E.	Ireland Mines Co., Maude H. Waldron, 2519 Ninth ave., San Francisco.....	3,200	18	M. M. R. Sierra, p. 92
Ireland.....	11	18 N.	10 E.	H. B. McCormick, W. L. Redding, Downieville; John Mayer, Sierra City.....			M. M. R. Sierra, p. 92; XVIII, pp. 506-507; XX, p. 17
Ironsides.....	20	19 N.	11 E.	L. & Thomas Buckingham, Yuba City; G. Powell, Marysville; Mrs. Margaret Ward & Cooley Butler.....	5,000	160	M. M. R. Sierra, pp. 93-94
Jim Crow.....	9	19 N.	11 E.	John Reid, Downieville.....	5,000	20	M. M. R. Sierra, p. 94
Juniper & Tippecanoe Gr.....	1	19 N.	10 E.	L. Foss, Downieville.....	4,500	40	M. M. R. Sierra, pp. 94-95
Kanaka.....							XL, p. 404; XIII, p. 379; M. M. R. Sierra, p. 95
Kanaka.....	8, 9	18 N.	10 E.	Ambrose Madden, Alleghany.....			XVIII, p. 507
Kate Hardy & Dordlict.....	29, 32	19 N.	10 E.	Kate Hardy Mng. Co., 411 B st., Santa Rosa.....	4,200	35	M. M. R. Sierra, p. 95; XVII, p. 475; XVIII, pp. 507-508; XX, p. 17; Pre. Rep. 8, p. 39; U. S. G. S. Bull. 580, p. 181



Kenton.....	4	18 N.	10 E.	Dr. Royal, Pasadena.....	3,200	60	M. M. R. Sierra, p. 97, XVIII, p. 508
Kenton Annex.....	27	20 N.	13 E.	W. H. Rowe, et al., Nevada City.....	4,500	40	M. M. R. Sierra, pp. 97-98
Kentucky.....	5, 6	19 N.	12 E.	E. A. Loeffler, Sierra City.....	5,500	50	X, pp. 653-654; XI, pp. 403-404; XIII, p. 379; M. M. R. Sierra, p. 98; XVIII, p. 737; U. S. G. S. Folio 37
Keystone.....	32	20 N.	12 E.	E. M. Innes, Sierra City; James Davis, Grass Valley.....			M. M. R. Sierra, p. 98
Keystone G. Mng. Co.....	24	19 N.	10 E.	J. R. Powell, Plymouth, Pa.....	5,000		M. M. R. Sierra, p. 98
King Cons. Group.....	36	19 N.	10 E.	John Hayes, Sierra City.....	5,000		M. M. R. Sierra, p. 98
Kinselbach.....	36	19 N.	10 E.	Langdon Smith, et al., Forest.....	4,000	60	M. M. R. Sierra, p. 98
Lawler.....				R. McIntosh, San Francisco.....	5,000		XII, p. 269; XIII, p. 380; M. M. R. Sierra, p. 99
Little John & Klondike.....							See Gabland Mine
Lonesome Phe.....	8	19 N.	11 E.	Homer Gould, Downieville & John Donnelly, Sacramento.....	4,000	40	M. M. R. Sierra, p. 99
Lone Star Group.....	25	21 N.	11 E.	Lone Star Cons. Gold Mng. Co., Mr. Thomas, Grass Valley, Secy.....	6,750	52	XI, p. 405; XII, p. 268; XIII, p. 379; M. M. R. Sierra, p. 99
Lorenzo.....	26	21 N.	11 E.	P. Lorenzo, Johnsville.....	6,000		M. M. R. Sierra, p. 99
Lost Treasure.....	20	19 N.	10 E.	Fred Phippin & Wm. Davies, Forest City.....	4,500	40	M. M. R. Sierra, pp. 99-100
Luella.....	22	21 N.	10 E.	James D. Alexander, Downieville.....	6,000		M. M. R. Sierra, p. 100
Mammoth Springs.....	26	19 N.	10 E.	Mammoth Springs Mng. Co., J. W. McGuire, 2506 Folsom st., San Francisco.....		230	M. M. R. Sierra, pp. 100-101
Mammoth.....	2	21 N.	10 E.	Richard Sparling Estate, Table Rock, & Mrs. Strand.....	5,500	20	M. M. R. Sierra, p. 101
Marguerite.....	3	20 N.	12 E.	Westall Bros., Sierra City.....	3,900		M. M. R. Sierra, p. 101
Mariposa.....	34	19 N.	10 E.	Mariposa Mines Assn., H. Fellenz, Secy., Theresa, Wis.....	4,400	37	XIII, p. 379; M. M. R. Sierra, p. 101; XVII, p. 475; XVIII, pp. 508-509
Mascot.....	2, 3	18 N.	10 E.				See Sovereign
Mercer & Salinas.....	25, 26	20 N.	10 E.	C. J. York, Downieville.....	5,700		X, pp. 649-650; XI, pp. 413-414
Mexican Group.....	10, 11	19 N.	10 E.	M. C. Mitchell, c/o California Cotton Mills, Oakland.....	4,000	100	M. M. R. Sierra, p. 102
Mineral Mtn.....	14, 15	19 N.	10 E.		3,800		M. M. R. Sierra, p. 102
Minnesota Dev. Group.....	2	18 N.	10 E.	Minnesota Dev. Co., J. O. Jones, Forest City, Supt.....			XIII, pp. 379-380; M. M. R. Sierra, p. 103
Minnie D.....	34	19 N.	10 E.	Albert Holm, Alleghany.....	4,400	30	M. M. R. Sierra, p. 103
Moonshine.....				George W. Hallock, Alleghany.....			XVIII, p. 510
Monarch.....	18, 19	20 N.	12 E.	J. H. & F. M. Lee, Sierra City.....	6,500	520	M. M. R. Sierra, pp. 103-104; XVII, p. 475
Montpelier.....	26	20 N.	10 E.	Owners, Mrs. Emma Hughes, Reno, et al. Lessee, J. R. Stark, Downieville.....		20	
Monroe Cons. Group.....	35	19 N.	10 E.	Monroe Cons. Quartz Mng. Company.....		29	M. M. R. Sierra, p. 104

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TABLE OF QUARTZ MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Eleva- tion, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Morning Glory-----	34	19 N.	10 E.	Estates of Martin & Christina Rohrig, Alleghany-----	4,500		M. M. R. Sierra, p. 105; XVIII, pp. 509-510
Morning Sun-----	35	19 N.	10 E.	F. W. Nicholls, Alleghany-----			XVIII, p. 510
Mountain (Bonanza)-----	16	20 N.	12 E.	F. R. Wehe, trustee, 74 New Montgomery st., San Francisco-----	6,500		X, pp. 647-648; XI, p. 402; XII, p. 289; XIII, pp. 371-372; M. M. R. Sierra, p. 105
Mountaineer-----	5	20 N.	12 E.	G. Scott, Downieville-----	6,100		XIII, p. 380; M. M. R. Sierra, p. 105
Mountaineer-----	24	21 N.	12 E.	Harry Morris-----			M. M. R. Sierra, p. 105
Mountain Ledge-----							See Mountain
Mount Fillmore Cons. Group-----	34	22 N.	10 E.	Frank Bonnet, La Porte; A. D. Post, Agent, La Porte-----		80	XII, p. 269; XIII, p. 380; M. M. R. Sierra, p. 105
Mount Moriah-----							See Lawler Claim
Myrtle-----							VIII, p. 579
New York-----	3	21 N.	10 E.	Wm. Schuld, La Porte-----	3,500		M. M. R. Sierra, p. 106
Night Hawk-----				P. T. Turner, La Porte-----			M. M. R. Sierra, p. 106
Northern Bell Group-----	31	20 N.	12 E.	L. Rosenfeld, San Francisco; Northern Bell Mng. Co.-----	4,300		M. M. R. Sierra, p. 106
North Fork-----	21	19 N.	10 E.	North Fork Mng. Co., 1024 Mills Bldg., San Francisco-----	4,900		XIII, p. 380; M. M. R. Sierra, pp. 106-107; XX, p. 18
Oakland-----	13	21 N.	11 E.	F. A. Gowing-----			M. M. R. Sierra, p. 107
Oasis-----	4	18 N.	10 E.	Oasis Mg. & R. Co., Thos. H. Allen, Jr., 433 S. Spring st., Los Angeles-----		40	
Old Mexican-----	9, 10	19 N.	10 E.	Bachels Bros., Goodyears Bar-----	5,000	60	
Ophir-----							XVIII, pp. 510-511
Oriental-----	33	19 N.	10 E.	Oriental Gold Mng. Co., Box 1102, Sacramento, Issesee-----	4,050	153	M. M. R. Sierra, pp. 107-108; XVIII, p. 511; XX, p. 18
Oriframe-----	3	18 N.	10 E.	L. D. Nihell & Jack Langman, Alleghany-----			XVIII, p. 511
Original 16 to 1-----	3, 4	18 N.	10 E.	Original Sixteen to One Mng. Co., 607 Monadnock Bldg., San Francisco; H. U. Maxfield, Pres.-----	4,400	64	M. M. R. Sierra, pp. 122-124; XVII, p. 475; XVIII, pp. 143, 514-517; XIX, p. 73; XX, pp. 17-18; Pre. Rep. No. 8, p. 39; U. S. G. S. Bull. 580, p. 175
Oro-----	35	20 N.	10 E.	Downieville Mng. Co., Chas. Herron, et al., Downieville-----	3,600	47	M. M. R. Sierra, p. 108; XVII, p. 475; XVIII, p. 737
Oseola Gr. (incl. Yellow Jacket)	2	19 N.	10 E.	Estate of R. G. Gillespie, c/o B. F. Stewart, Jr., Admr., 2655 Wakefield ave., Oakland-----	4,600	21	XI, p. 407; M. M. R. Sierra, pp. 108-109; XVIII, pp. 511-512; U. S. G. S. Bull. 580, pp. 17-174

Oxford	22, 23 26, 27	20 N. 21 N.	10 E. 10 E.	Oxford G. Mng. Co., H. H. Meyers, Downieville.	3,400	189	XII, p. 269; XIII, p. 381; M. M. R. Sierra, pp. 109-110; XX, p. 18
Pacific Alta Group	12	21 N.	9 E.	D. Conlan, St. Louis, Cal., c/o La Porte.	5,000		XIII, p. 381; M. M. R. Sierra, p. 110
Pat Young	29	20 N.	12 E.				M. M. R. Sierra, p. 111
Phoenix	21, 22	20 N.	12 E.	Heirs of C. J. Winstead in litigation with heirs of J. W. Kane	6,500	124	X, p. 653; XI, p. 402; XIII, p. 381;
	28, 29	20 N.	12 E.	Dos Pesos Estate, New York	4,680	343	M. M. R. Sierra, pp. 111-112
Pilgrim	29	19 N.	11 E.	Croesus Gold Mng. & Mfg. Co., 734 Fifth ave., New York	5,000	164	M. M. R. Sierra, p. 112
Plumbago	2	18 N.	10 E.				XII, p. 270; XIII, p. 381; M. M. R. Sierra, p. 112; XVIII, pp. 143, 512-513; XIX, p. 73; XX, p. 18
Primrose	13, 14	20 N.	11 E.	Mrs. M. D. Cogwell, Graniteville; Adolph Siebrecht, 350 Anza st., San Francisco. Lease & option to James Thelender, Seattle, Wash.	6,200		
Prospect	2	19 N.	10 E.	Prospect Mng. Company	3,600	96	M. M. R. Sierra, p. 113
Rainbow	2, 3	19 N.	10 E.	Rainbow Gold Mng. Co., E. L. Gould, Secy., 1007 Sutter st., San Francisco	4,000	94	VIII, p. 578; XI, p. 407; XII, p. 270; XIII, p. 381; M. M. R. Sierra, pp. 113-114; XVIII, pp. 143, 513; XX, pp. 17-18; Pre. Rep. No. 8, p. 39; U. S. G. S. Bull. 580, p. 177
Rainbow Extension	3	18 N.	10 E.	San Jose Mfg. & Invt. Co., O. A. Harlan, San Jose			XVIII, p. 513
Rao (RaO)	34	19 N.	10 E.	R. T. Garnier, 1735 Mission st., So. Pasadena		14	M. M. R. Sierra, p. 114
Red Chief							See Red Lodge
Red Jacket	12	18 N.	9 E.	Thomas Rose, Pike City			M. M. R. Sierra, p. 114
Red Lodge				Bank Mng. & Promotion Co., W. H. Barnhart, Pres., Buffalo, N. Y.			M. M. R. Sierra, p. 114
Red Star	27, 34	19 N.	10 E.	Tightner Mines Co., 709 Balboa Bldg., San Francisco		140	XVIII, p. 519
Reese Ravine				Reese Ravine Mng. Co., 655 Congress st., Portland, Me.			
Republic Gr.	17	19 N.	11 E.	A. B. Jenkins, Tuolumne			M. M. R. Sierra, p. 115
Rising Sun	35	19 N.	10 E.	F. Morton, San Francisco & Alfred B. Morton, Baltimore, Md.	4,430		VIII, p. 579; XI, p. 418; XIII, p. 382; M. M. R. Sierra, p. 115; XVIII, pp. 513-514
Roman	3	19 N.	12 E.	Big Avalanche Mfg. Co., Inc., 170 6th St., San Francisco	5,000		M. M. R. Sierra, p. 115
Sacred Mound	20, 21 28	20 N. 20 N.	12 E. 12 E.	Richard Phelan, Phelan Bldg., San Francisco & Dennis Phelan, Sierra City. Lease & option to California Buttes G. Mng. Co., T. Leonard Parks, Pres., Los Angeles or Box 145, Sierra City	5,000		M. M. R. Sierra, pp. 115-116
Salinas & Mercer	35	20 N.	11 E.	Ed Freeman, Sierra City	5,700		M. M. R. Sierra, p. 116
San Lois	6	19 N.	12 E.	Mitchner Mng. Co., & H. Mitchner, San Francisco	7,000		M. M. R. Sierra, p. 116
Scotia & Alice Cons.							XIII, p. 382

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TABLE OF QUARTZ MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Secret Canyon	1	19 N.	10 E.	George Henk			M. M. R. Sierra, p. 117
Shamrock Gr.	28, 29	20 N.	12 E.	John C. Mansfield, Sierra City	5,000	400	M. M. R. Sierra, p. 117
Shaughnessy	32	20 N.	11 E.	Wm. Shaughnessy, Downieville			M. M. R. Sierra, pp. 117-118; U. S. G. S. Bull. 580, p. 175
Sherman	34	19 N.	10 E.	Bradbury Estate, Mrs. E. J. Jenkins, Seattle		25	
	3, 4	18 N.	10 E.				
Sierra Alaska	5, 8	18 N.	9 E.	Sierra Alaska Mng. Co., Pike City; W. S. Schuyler, Box 1367, Carmel	3,500	311	VI, pt. 2, p. 58; XII, p. 261; XIII, p. 371; M. M. R. Sierra, pp. 118-119.
Sierra Buttes	19, 20	20 N.	12 E.	E. A. & J. O. Hayes, San Jose	6,000	1,020	VI, pt. 2, p. 56; VIII, p. 573; X, p. 643; XI, pp. 402, 416-417; XII, p. 272; XIII, p. 382; M. M. R. Sierra, pp. 119-121
	28, 29	20 N.	12 E.				XIII, pp. 382-383
	31	21 N.	12 E.				See Albambra Group
	6, 7	20 N.	12 E.				M. M. R. Sierra, p. 121
	24	20 N.	10 E.	Sierra Poorman Mng. Co., Downieville			See Original Sixteen to One
Sierra G. Mng. Company	4	20 N.	11 E.				M. M. R. Sierra, p. 122
Sierra Phoenix							XIII, p. 383; M. M. R. Sierra, p. 124
Sixteen to One	22	20 N.	10 E.	Standard Mines, R. E. Blevins, Williams	4,250	80	M. M. R. Sierra, p. 125
Standard	3	19 N.	10 E.	L. Copeland, 530 California st., San Francisco	3,500		
Slug Canyon Tunnel Co.	24	20 N.	11 E.	Pacific Coast Real Est. & Investment Co., Monterey; Dr. Roberts, Monterey, Pres.	5,500	200	
Sovereign							See Comet-Sovereign
Sovereign-Comet							XX, p. 366
Star							XII, p. 273; XIII, p. 383
Sunset							X, pp. 652-653; XI, pp. 402-403; XIII, p. 374; M. M. R. Sierra, pp. 125-126
Swastika Mng. Company	26, 27	20 N.	12 E.	Swastika Mng. Co., 304 Kohl Bldg., San Francisco	4,675	158	
Taber	25	22 N.	9 E.				XII, p. 273; XIII, p. 384
Telegraph Mng. Co.	4	20 N.	10 E.	H. S. Tibbey, et al.	5,340	500	XI, pp. 410-412; M. M. R. Sierra, p. 126
					6,000	340	
Tightner (exc. Red Star)	27, 34	19 N.	10 E.	Original Sixteen to One Mng. Company	5,000		M. M. R. Sierra, pp. 127-129; XVII, p. 475; XVIII, pp. 143, 517-519; XIX, p. 73; XX, p. 83; Pre. Rep. No. 8, p. 39; U. S. G. S. Bull. 580, pp. 171-173
Tomboy Eureka	29	19 N.	10 E.	O. R. Bixby, Forest	1,300	40	M. M. R. Sierra, pp. 129-130
Topsey				E. Prosser, Martinez			XX, p. 365

True Fissure Group-----	19, 30	21 N.	12 E.	True Fissure Cons. Qtz. Mng. Co., Geo. Reynolds & Bishop, San Francisco	7,400	90	XI, pp. 405-406; XII, p. 274; XIII, p. 384; M. M. R. Sierra, p. 130
Twenty-One-----	34	19 N.	10 E.	Original Sixteen to One Mng. Co.	3,500	60	M. M. R. Sierra, pp. 130-131; U. S. G. S. Bull 580, p. 174
Twenty-Two & Twenty-Three-----	3	18 N.	10 E.	Lester I. Mather, 3515 Fifth ave., Sacramento	-----	-----	-----
Ureline-----	35	20 N.	11 E.	-----	-----	-----	-----
Van Cliff-----	5, 6	18 N.	11 E.	-----	-----	-----	-----
Wheeler, Yuba & Montpelier-----	26	20 N.	10 E.	Emma Hughes, 512 N. Virginia st., Reno	3,300	-----	See Slug Canyon Tunnel Company
William Tell-----	34	20 N.	12 E.	W. H. Williams, Agt., Sierra City	5,000	-----	M. M. R. Sierra, p. 132
Wonder-----	-----	-----	-----	Wonder Gold Mines, Inc., 532 Sixteenth st., Oakland	-----	-----	X, p. 653; XI, pp. 415-416; XII, p. 275; XIII, p. 384; M. M. R. Sierra, p. 132
Willoughby-----	25	21 N.	11 E.	Gold Basis Mng. & Mg. Co., 1608 Webster st., Oakland; Robert Jump, Fruitvale; Ernest Farrel, Downieville	-----	100	M. M. R. Sierra, pp. 132-133
Wolf Creek-----	12	18 N.	10 E.	Independence Mng. Co., Alleghany	-----	18	-----
Yellow Jacket-----	35	20 N.	11 E.	Under option to Alleghany El Dorado G. Mng. Co.	-----	-----	See Osceola Group
Yellow Jacket & Bear Creek-----	28, 33	19 N.	11 E.	Little Bear Creek Mng. Co., 260 California st., San Francisco	4,650	40	-----
York-----	-----	-----	-----	-----	-----	-----	See Finney
Young America-----	8, 9	20 N.	12 E.	S. M. Green, Denver, Col.	6,500	-----	X, p. 643; XII, p. 275; XIII, p. 384; M. M. R. Sierra, pp. 133-134; U. S. G. S. XVII Rpt., pt. 1, p. 653
Yuba Cons.-----	10, 11	18 N.	10 E.	Sierra-Yuba Gold Quartz Mng. Co., J. L. Fields, trustee, 2141 Clinton ave., Alameda	-----	60	M. M. R. Sierra, p. 134

Names and addresses of owners shown herein are those given in county tax records. The names and ownerships of many idle mines have changed but are given to facilitate reference to the old reports.

## GOLD (PLACER MINES)

The drift and hydraulic mines of the Howland Flat ridge in the northwest corner of the county, and of the lava-covered divide extending from American Hill west to the county line between the Middle and North Forks of Yuba River as well as those in the ridges north of Downieville, were active from the late fifties up until 1880. Since then hydraulic mining has been carried on at a few places, and prospecting for drift mines has persisted. Hydraulic mines in the North Yuba drainage now have an opportunity to buy storage space behind the dam of Yuba River Power Company at Bullards Bar at a cost of three cents a cubic yard, measured at the mine. Some of the drift mines have been worked out, but in a great many more cases the cessation of production was due to the pay channels being lost where they were faulted, or cut out by later barren channels. This is the condition existing at many claims prospected in later years. These claims in their earlier history yielded gravel of a sufficiently high gold content to pay a profit even under present conditions, if the unworked segments of channels could be opened.

Most of the drift and hydraulic mines are situated so high in the mountains that roads and trails to them are passable with difficulty, if at all, after the first heavy storm. Accordingly, all material and supplies for winter operation should be delivered at the mines before the end of October. Most small companies make no attempt to operate in the winter, so that the aggregate amount done annually is small. There are at present no large placer mining operations in the county.

Hydraulic mining has been hampered in late years by a short water supply, aggravated by several seasons of scanty rain and snowfall. The present season, to the middle of April, 1929 has also been unusually dry and cold.

The accompanying table gives the number of drift, hydraulic and surface placer mines in operation in Sierra County during the past 14 years, with their output.

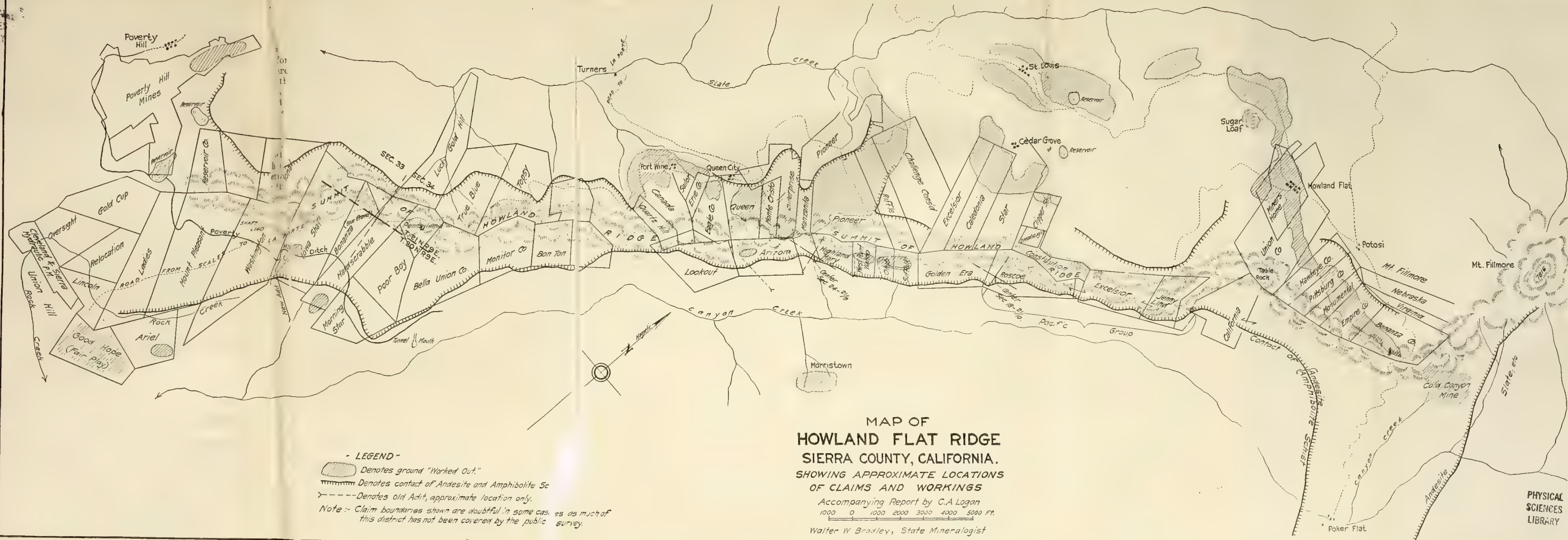
*Synopsis of Placer Gold Production, Sierra County, 1914-1928.\**

<i>Year</i>	<i>No.</i>	<i>Drift Output</i>	<i>No.</i>	<i>Hydraulic Output</i>	<i>No.</i>	<i>Surface Output</i>	<i>Total Placer</i>
1914	10	\$31,931	6	\$83,217	8	\$ 3,370	\$118,518
1915	6	13,282	3	44,177	7	6,969	64,428
1916	10	11,063	3	48,820	6	11,060	70,943
1917	8	13,267	4	29,710	7	18,166	61,143
1918	11	11,682	4	13,037	5	3,884	28,603
1919	7	3,166	4	33,436		6,009	42,611
1920	6	5,813	2	19,487			25,300
1921	2	3,103	4	14,520	9	3,351	20,974
1922	9	11,085	4	25,102	3	394	36,581
1923	12	5,173	4	18,609		874	24,656
1924		18,015		6,199		2,127	26,341
1925	7	4,886	5	24,542	7	2,080	31,500
1926	4		3		15		17,478
1927							27,594

\*From Annual Statistics of U. S. Geological Survey and U. S. Bureau of Mines.

The numerous ancient channels of the county have been frequently described, particularly in the publications of the State Mining Bureau, and the list of placer mines given herewith contains a reference to such past reports on the various mines under the heading "Bibliography." The folios of the U. S. Geological Survey, numbers 37









(Downieville) 66 (Colfax) 18 (Smartsville) and 43 (Bidwell Bar) cover the geology of the western mineral-bearing section of the country.

One of the important ancient channel systems in the country was the one extending from La Porte in Plumas County, by way of Poverty Hill, Mount Pleasant, Scales, Brandy City, Indian Hill and Depot Hill. The last two named are the only active mines this season on this channel. There are large yardages of gravel suitable for hydraulic mining still left along its course. Several of these are described herein. All these bodies of gravel are tributary to North Fork of Yuba River and consequently can buy storage space behind Bullards Bar dam. Several other small hydraulic mines in the North Yuba basin have been preparing to work and take advantage of this storage, but have been hampered by short water seasons.

In the northwestern corner of the county, extending from Mt. Fillmore to Scales, are the Howland Flat Ridge and the adjacent mining camps of Cedar Grove, Grass Flat, St. Louis and others on its north or Slate Creek side and Morristown and Poker Flat on the south or Canyon Creek side. This region was, as a whole, the most productive placer mining district in the county. The Port Wine channel is the name given to the east branch of the ancient equivalent of the North Yuba River. This east branch has generally been thought to traverse the region from Mt. Pleasant (where it joins the larger La Porte-Scales-Brandy City branch mentioned above) through the Iowa Shaft, Port Wine, Queen City, Grass Flat, Gardners Point, St. Louis and Howland Flat. The channel was worked at the Iowa Shaft claim over 40 years ago. This is a mile or more northeast of Mt. Pleasant. A series of drill holes put down several years ago across the Hardscrabble and Blue Gravel (Bonanza) claims tended to prove that the channel crosses the south end of the Blue Gravel and the middle of the Hardscrabble claim. From there to the Bunker Hill claim near Port Wine, where extensive work has been done, is a distance of  $2\frac{1}{2}$  miles in an air-line and the channel has not been worked in that section. From the Quartz Hill claim north and east there is an almost continuous line of workings to Grass Flat,  $2\frac{1}{2}$  miles north. The elevation of bedrock in the lowest workings at the Iowa shaft was 4582 feet; at Port Wine it is 4853 feet. In the Monte Christo workings, which are three-fourths mile northeast of Port Wine and were run about 1875, it was reported that the upstream segment of the channel was faulted down 50 feet. The principal workings swing to the north from here and consist of extensive hydraulic pits, while to the northeast are several drift mines, of which the Happy Hollow (Arizona), Wahoo, Ohio & Suffolk, and Excelsior were productive.

There is some uncertainty as to the identification of the channels in this section. It is not definitely established whether the series of drift mining claims last mentioned are on a bench or on a tributary of the Port Wine channel. The bedrock at the Pioneer claim is said to be 100 feet lower than at the Suffolk and it is claimed by some that a rim lies between them, running north and south. This 'rim' may be a fault face as the La Porte fault zone continues across this ridge.

Active prospecting of drift mining claims has been going on at different places between Scales and Howland Flat during the past few years, as described herein. Some hydraulicking has also been done.



The drift mines at Alleghany were worked in the '50's' and '60's' and these operations led to discovery of some of the quartz veins which have kept the county in the list of important gold producers. At Forest, the Bald Mountain drift mine was the largest producer of placer gold in the county, the gross output being \$3,100,000 of which \$1,300,000 was distributed in dividends up to the time of closing in 1887. Along the ridge south of North Yuba River, from American Hill to Camptonville, there are many segments of unworked channels, some of which offer good opportunities. Beginning at the east, the following is a list of the various channel segments known. More work, or a closer study of the geology, would no doubt result in correlating several of these as segments of the same channels, which have been partly eroded by intervolcanic or recent streams, or have been faulted: American Hill, Emigrant, Maple Grove, Bald Mountain Extension (tributary to Great Blue Lead), City of Six, Great Blue Lead (upper Bald Mountain), Deep Bald Mountain, North Fork, Young America, Corotoman Upper and Lower, Lucky Dog, Omega, Mountain House and Kanaka White Channel, Kanaka Blue Lead, (possibly tributary to last) Gale, True Grit, St. Clairs, Snowden Hill, Pleasant View, Halkyard, and La Porte-Camptonville.

Nearly all of these flowed south and west and some had their upstream sections in the ridges north of North Yuba River.

The following approximate figures<sup>1</sup> have often been quoted and are repeated here because the Bullard's Bar dam has made the basin of North Fork Yuba River the only district in the Sierra Nevada region where hydraulic mining may be followed without considerable preliminary outlay for debris restraining dams.

Principal deposits of hydraulic gravel available at present in basin of  
North Fork Yuba River.

	<i>Cu. Yds.</i>	
*Howland Flat and Pine Grove-----	1,375,000	(being worked in part)
*St. Louis, Greenwood, Grass Flat--	2,850,000	(worked in part since 1891)
Poverty Hill -----	4,000,000	
*Scales and Mt. Pleasant -----	30,000,000	(some work since 1891 at Scales)
Brandy City ----- 6,600,000 to	9,000,000	(worked irregularly since 1891)
Eureka North, Poker Flat, Chaparral		
Hill -----	1,400,000	
*Indian Hill -----	8,000,000	(working)

\*Indicates that bottom ground has been partly mined by drifting.

The descriptions of placer mines and placer mining operations which follow are intended to cover the work done since the publication of the State Mining Bureau's last county report, and descriptions are also included for a number of mines which have not heretofore been adequately covered.

*Arizona Drift Mine* is at the head of Jim Crow Canyon. It was worked years ago and after producing profitably the channel was lost where cut off by a lava-filled trough. For the past eleven years Hugh McCormick, Taylor and associates of Downieville have been prospecting for the remaining segment of channel but so far have not succeeded in finding it. They expect to resume work this spring.

*Bald Top Hydraulic Mine* was partly equipped with buildings and flumes in the fall of 1926, but work was not completed in time to permit

<sup>1</sup>House Ex. Doc. 267, 51st Congress, 2d session, 1891, p. 83.

mining during that season. It was operated during the water season of 1927-1928. This mine is six miles by road northeast of Brandy City.

*Big Channel Mining Company*, 1616 Webster street, Oakland, a Nevada corporation, was incorporated in August, 1926, to work the *Rifle, Challenge, Comet* and *Port Wine Consolidated* claims between Port Wine and Cedar Grove. Applications to appropriate water from Deacon Long Ravine, Sawmill Ravine, Canyon Creek and Cedar Grove Ravine were filed in March and July, 1927, but permits have not been issued due to failure of the company to take necessary steps. There is also a protest against one proposed diversion. No activity on the company's part has been noted since November, 1927. The so-called lower run, a wide body of gravel, was extensively hydraulicked on these claims at an early date.

*Black Bear Drift Prospect* is between the old Telegraph mine and Eureka, nearly 10 miles northwest of Downieville by state highway. Two placer claims cover nearly a mile each. The same owners relocated the Telegraph under the name of Pilot, Pilot No. 1 and Pilot No. 2, covering 4500 feet on the strike of the vein.

The Telegraph (see bibliography in mine list) was worked first as a drift mine and was a good producer. In the course of placer mining, a valuable quartz vein was discovered, and later another. A 5-stamp mill was erected which was taken out twice by snowslides. The channel was faulted, and was lost after breasting out available gravel. The quartz veins do not outcrop, as they are covered by the lava cap, which is up to 1000 feet thick. This has made it expensive to prospect the main vein, which is on the contact of slate and serpentine.

Considerable prospecting both for the quartz vein and the gravel channel has been done in late years. A new prospect adit on the Black Bear is about 3000 feet south and west from the portal of the old Telegraph adit, and has been run nearly 1000 feet, including raises. There has been no recent production.

*Blue Gravel Mines Consolidated* has held leases and options for over two years on the *Iowa, Hardscrabble, Blue Gravel, Bonanza, Iowa Consolidated Tailing claim, Poor Boy, Bella Union*, and *Bon Ton* placer mining claims on Howland Flat ridge about midway between Port Wine and Scales on the Port Wine Channel.

In 1926 and 1927 an adit was run 2900 feet, of which 2427 feet has a direction N. 60° W., and the rest N. 35° W. to N. 40° W. This adit enters the Iowa claim near the west property line. It crosses a body of gravel which is evidently well above bedrock. The gravel is fine in size, contains a great deal of mud and granitic sand, and considerable lignitized wood; all evidences of flat grade and eddying water, probably associated with a damming up of the stream below and with flood conditions. The rim rock is oxidized, decomposed, soft and seamed as if exposed for a long time to the air. Such rock could not have lain in the channel, as the running water and moving gravel and sand would have quickly cut it away. The face of the adit is in this soft oxidized schist. Some distance back from the face a winze was sunk 14 feet and is said to have struck hard bedrock, indicating the adit at this point was too high. A raise at the 2400-ft. point is in gravel, but evidently no pay gravel was found.



The old Iowa shafts, of which two were vertical and the other inclined, were sunk 300 to 350 feet northeast of the face of this adit. From these, the channel was worked in a northeasterly direction for a distance variously reported at from 600 to 1200 feet, and the output, at the rate of \$1.75 to \$2 a car, is estimated at \$30,000 by one writer and \$85,000 by another. The work was done in the seventies, principally, and no definite record of it remains; but it appears that some profit was realized. The bedrock elevation at the lowest point mined was 4582 feet, but the idea has persisted that a channel may lie to the west. The trough of the channel worked is reported rocky and cemented, and the pay is supposed to have come from gravel 16 feet above bedrock.

From its present face, the new adit would have to be driven through all this previously worked ground, (probably at excessive if not prohibitive cost) in order to reach unworked gravel upstream; the evidence of a main channel further west is meager, and the segment of channel between the property line and the old shafts was too small to justify such a long adit.

Work ended September 30, 1927, and on October 19, 1927, all the title and interest of the Blue Gravel Mines, Consolidated, was attached by the sheriff on account of unpaid bills. It is stated that previous to that time a chattel mortgage had been given on the entire holdings of the company to Guardian Investment Company, Los Angeles.

The plant, in a building at the adit portal, includes a 120-h.p. Diesel engine, air compressor with capacity of 720 cubic feet f.a. per minute, ventilator, drill sharpener, oil fired forge, 10 h.p. electric generator, 10 h.p. Doak gas engine, 30,000-gallon oil tank and two 1500-gallon oil tanks.

Through exchanges and sales of the respective stocks, *Pay Divide Mining Company*, a Nevada corporation, owned in January, 1927, 51% or 127,500 shares of the stock of Blue Gravel Mines, Consolidated. *Associated Mines, Incorporated*, in turn owned all the capital stock of Pay Divide Mining Company.

*Cleveland Hydraulic Mine* (formerly *Neocene Placer Mining Company*) at Scales, which was last worked in 1924-1925 by Scales Syndicate, has lain idle since that season when results were not up to expectations. This group now comprises the *Cleveland and Sierra, Oversight, Gold Cup, Reservoir, Relocation, Lincoln, Baltimore, Good Hope, Southern, Wedge, Fairplay and Fairplay Extension* claims, over 1600 acres in all, patented. The property controls the first right to all water from Rock Creek, and has ditches with a capacity of 3000 to 4000 inches. A full head for hydraulicking can usually be expected to last not over 100 days annually. About 4,000,000 cubic yards have been hydraulicked at this property, and according to an estimate made years ago by U. S. Army engineers<sup>1</sup> there are 30,000,000 cubic yards of hydraulic gravel now available at Scales and Mt. Pleasant, which is the next property east, and is under different ownership. The ultimate estimated amount available is 60,000,000 cubic yards for the two properties.

The bank is 50 to 150 feet high, tight or slightly cemented in places, and contains many large boulders in fine gravel and volcanic ash. The

<sup>1</sup> Fifty-first Congress, 2d session 1891—House Executive Doc. 267, p. 83.



channel is about one-fourth mile wide and the property is claimed to cover a mile and a half in length along it. Part of the property covers the supposed junction of the La Porte and Port Wine channels.

The many large boulders have offered the principal operating problem, and the time required to break and move them out of the way reduced the daily capacity of the operations and the full advantage of the maximum water supply could not be realized. Andrew Nesbit, superintendent for the last operators, erected two high line derricks for handling sand boulders but did not have time to give his method an adequate trial.

During previous work, prior to 1918, the Neocene Placer Mining Company, then operating the mine, built a tailing dam about four miles below Scales at a cost of \$12,000, but natural erosion and mine debris from only one year's work filled it. Another scheme tried was to pile the boulders across the channel below the workings and then run the sand and fine gravel through a small sluice dumping on top of this rock pile so as to fill the interstices and form a tailing dam. The last operators paid three cents a cubic yard (measured at the pit) for tailing storage behind Bullards Bar dam. Two to three thousand inches of water is the average supply.

*E. Crowell Prospect*, between the Gibraltar and Sunnyside drift prospects, has a shaft 280 feet deep which is said to show fine gold. It is rim gravel and Crowell planned late in the summer to sink an incline into the channel. The hoist and pump are operated by steam.

*Depot Hill Hydraulic Mine* is five miles east of north of Camptonville on the Downieville state highway lateral and at the west county line. It has been worked every season that water has been available since 1855, according to the owner, and is evidently the oldest operating hydraulic mine in the state. For many years it has been the property of the Joubert family. About  $1\frac{1}{4}$  miles of channel has been worked but the total production is said to be unknown on account of the number of separate early day holdings later consolidated. At least a million dollars and probably over  $1\frac{1}{4}$  millions would be a reasonable estimate, without making allowance for the richer gravel in the trough of the tunnel, which has been worked out. The present operations are on the south rim and there is enough gravel left on the north rim for a few seasons' work.

The deposit is a remnant of the La Porte-Scales-Brandy City channel. The bank of rim gravel being worked is 75 to 110 feet high and is fine quartz gravel and sand with very few cobbles over six inches in diameter. The pay gravel is a layer four to 12 feet deep next to bedrock, and is often bluish and partly cemented. Above this is a black layer up to three feet thick which is colored by lignitized fragments of wood and other vegetation, and carries numerous nodules of pyrite. This layer evidently marks a period when the stream was ponded and lost velocity because of reaching its grade, after which time the fine gravel and sand was piled up on the rims, due to the stream's loss of transporting power or diminution of flow. This fine, upper gravel is stated by F. J. Joubert, the owner, to be nearly devoid of gold.

The upper gravel is washed off into the sluices as fast as possible, but the lower pay stratum is carefully handled and washed in the pit

until it is thoroughly broken up. Some blasting is done. Water is brought to the mine under 160 feet fall through seven miles of ditches tapping branches of Indian Creek, Grants Ravine and north and south branches of Oak Valley Creek. A full supply is 600 to 700 miner's inches, but in later years the water supply has generally been irregular or small. The period 1902-1916, except 1912 is characterized as a good one by Joubert, who says the season of 1920-21 was the last really good one as regards water supply. In 1903 they piped for 4200 hours, while in 1928 they had water sufficient for only 1310 hours. Up to April 3, 1929 only three hours piping had been done. Two giants are set up for use.

The water duty and capacity of operations are limited by the very flat grade of the ground sluice, only three inches in 14 feet. Top gravel is handled over twice as fast as the lower pay gravel, but the average daily duty per miner's inch of water is less than a cubic yard. However, the mine has been a profitable one over a long period of years due to careful and intelligent handling, with no unproductive overhead expense. There is 5100 feet of 2 ft. by 2½ ft. flume of which 3500 feet is now in use. It is paved with 7-inch pine-block riffles. Although the gold is all fine, the recovery is reported very high and is made at or near the head of sluice. The gravel is reported to run 10 cents to 20 cents a cubic yard in gold. Tailing storage was formerly behind their own concrete dam, but this was considered full by the California Debris Commission when 500,000 cubic yards had been stored, since which time space behind the Bullard's Bar dam has been purchased at three cents a cubic yard.

*Deadwood Mine*, in the old Deadwood district four miles southeast of Howland Flat, was taken under option in 1927 and Deadwood Mining Company was incorporated. In October, 1928 a petition was filed in the superior court at Downieville seeking the voluntary dissolution of the corporation.

The exposed part of the Deadwood deposit was hydraulicked at an early date, and the channel was then followed about a mile by drifting under the lava south of east to the Bunker Hill claim. Numerous faults and lava dikes are said to have been found. In late years only assessment work has been done.

*Eleanor Placer Mining Company* has been organized by Charles E. Herron, Downieville and others, to work the *Owens* or *Eleanor* hydraulic mine at Mugginsville on Eureka Creek, a branch of Good-year Creek, five miles north of Goodyear Bar. Some of the ditches had been cleaned out and repaired and pipe laid for hydraulicking by the end of November, 1928. The same interests are working on the *Erwin* ground, preparing to extend an adit run years ago by Brady. In January 1929, two men were repairing the sluices at the Owens mine.

A clean-up of a few thousand dollars was reported from the property as the result of a short run in the spring of 1928. Hydraulicking was resumed early in April, 1929.

The operation of the Mugginsville property is said to have been prevented for a long period of years because the gravel and the water supply needed to work it were under separate ownerships.



*Gibraltar Drift Prospect* contains nine association placer claims, covering two miles of the supposed course of the channel, which is deeply buried. It is reached by trail from Blairsden, Downieville or Table Rock; the upper part of the ground being so high that water is scarce at the shaft.

The prospect was first located in 1881 and was worked by Kieffer Brothers for many years, when the Gibraltar Consolidated Mining Company was formed. The work done in these earlier years included an adit 1780 feet long which proved to be 80 feet too high, another adit 900 feet long, and a winze sunk 310 feet to bedrock at a point 400 feet back from the face of the adit. Rim gravel was struck in these workings, but water flow encountered was too great to permit going down into the trough of the channel. Later the company sunk a shaft 310 feet deep and drifted northwest 100 feet and south 60 feet. In these workings, which were near the west rim, coarse gold was found and a few hundred dollars was produced each year during the short water season.

*Gibraltar Sierra Mining Company* was incorporated in November, 1925, to develop the property. A new tunnel, designed to cut through the west rim and drain the channel and permit cheaper mining, was started about three-fourths mile south of the shaft. After this had been run 1900 feet without striking gravel, the operators started a raise of 80 feet back from the face. This was put up 83 feet, when a higher level was started. Late in the fall of 1928 this was about 500 feet long. Gravel had not yet been found, although rock conditions were reported promising near the face. Another raise was put up over 90 feet above this upper level, without finding gravel. Work was continuing in December, 1928.

The property is equipped with log buildings, a 10 inch by 12 inch compressor, 75 h.p. gas engine, ventilating fan, compressed air drill plant, electric light plant, etc. Gravel had not been found up to April 1, 1929, though nearly 3000 feet of work had been done.

*Goodyear Bar Placer Company.* Mark R. Averill, Secretary, Federal Realty Building, 16th and Broadway, Oakland. The company was incorporated in December, 1926, and owns the Costa Ranch and holds adjoining placer locations. In May, 1927, the State Division of Water Rights granted them a permit to divert 60 cubic feet of water per second from Rock Creek. The company has been unable to finance the proposed hydraulic mining operations, which would entail an estimated outlay of \$65,000 for bringing water to the claims. Early in 1929 the holdings were for sale.

*Halkyard Drift Mine* is  $5\frac{1}{2}$  miles northeast of Camptonville, just west of the old Orient workings and north of the St. Clair property. Twenty-five partners, with B. F. McNaught as superintendent, are financing and personally carrying on the prospecting work.

The gravel channel was worked in early days through two shafts and several adits. An adit, 150 feet long on the east rim and another 1200 feet long on the west rim, were both too high, but the latter is said to have produced \$32,000. The shafts were 104 and 156 feet deep, respectively. The property line of the old Orient claims is only 100



feet east, and it is stated that a former operator of the Orient drove into the Halkyard and mined considerable gravel from that property. The present operators of the Halkyard were running a new adit S. 18° E. and this was 665 feet long at time of visit in October, 1928 and was within 40 feet of the first shaft. It is eight feet below the lower of the old adits. This is probably going downstream, though some engineers have claimed that the Pleasant View Orient channel is the only one of the region that flowed north.

The same people have relocated the Orient claims and have a lease on 200 acres of the St. Clair property.

*Hilo* (four placer claims) 4½ miles due north of Goodyear Bar, is one of the properties recently leased by the company which is represented locally by Charles Herron, Downieville.

*Indian Hill Mine* is seven miles by dirt road north of Camptonville or may be reached by a mile and a half of trail from the crossing of the state highway over Indian Creek, 6½ miles north of Camptonville, the former road being impassable in wet weather. The mine covers only part of the Indian Hill gravel deposit, Zerga and others owning claims on the west and south sides. The elevation of bedrock is 3217 feet, or less than 100 feet above that at Depot Hill.

The white quartz gravel forming the lower part of the Indian Hill Mine is a remnant of the great La Porte-Scales-Brandy City channel. This gravel, as exposed by previous hydraulic mining on two sides, is similar to that now being mined at Depot Hill. It is 100 feet or more in depth, of fine white and pink quartz gravel and sand. This quartz gravel is covered at Indian Hill by a later intervoleanic channel containing a great many boulders of schist and lava. If this upper run is to be connected with the gravel drifted at Snowden Hill, three miles east, a very steep grade would be required. Lindgren mentions the Indian Hill quartz channel as being covered at one time with andesitic breccia. This last run of breccia and lava mud forms a layer in places up to 50 feet thick on top of the intervoleanic channel last mentioned. The intervoleanic gravel on top of the quartz channel is said to carry good pay.

A large part of the lower gravel has been worked here in the past by drifting. Hydraulic mining in later years has been irregular. H. H. Ray leased ground from Massa on the south side and hydraulicked during part of two seasons with little production. Later F. S. Morgan did some work without success. The resumption of hydraulicking here was made possible by the building of Bullards Bar dam behind which storage for tailings is purchased. Late in 1928 the Indian Hill Mine was subleased by Morgan to F. W. Camp. Lack of water and other causes prevented Camp from doing much actual mining previous to April 3, 1929. At that time, when the mine was visited, three men were employed and the water supply was said to be sufficient for six hours piping daily.

The water supply comes from Humbug, Little Humbug and Indian Creeks through four miles of ditch and flume, including two siphons which are together 3500 feet long. There are three small reservoirs for storage above the penstock, from which the water falls 125 feet through about one-half mile of pipe, from three feet to one foot in diameter, to the pit. With a good water season and the reservoirs full, it is claimed

a 4-inch nozzle can be operated 9 to 15 hours a day. The present work is on the northeast side. There is a flume 900 feet long, of which 400 feet is in the sluice tunnel leading from the bank. Some trouble is experienced with sliding red soil overburdened at this pit.

A succession of poor water seasons and resulting inability to handle any large yardage after incurring the expense of fitting up, together with limited capital, have kept the recent operators from making an effective showing. There is claimed to be 5,000,000 cubic yards of payable gravel available; other estimates are higher.

*Kirkpatrick Mine* comprising the Kirkpatrick, Last Chance, Mag-nolia, Virginia-Clare and six other placer claims a mile and a half north of Mountain House, were sold at sheriff's sale in November, 1925. In November, 1926, Charles G. Johnson, Sacramento, and associates bought control of the property. An adit was begun in the direction of the east rim of the channel in July, 1927, but in February, 1928, it was reported that although a prospect was struck, the adit was too high, necessitating a new one. Work has continued, and late in 1928 a new corporation, to be called Kirkpatrick Mines, was being formed.

*Loftus Blue Lead Mines Company.* John M. Longan, President, 1119 Guaranty Building, Hollywood, California, has extensive holdings in St. Louis, Howland Flat and Poverty Hill districts, including placer mining claims, ditches, reservoirs and water rights and a sawmill. They also have under lease and option the Wehrle No. 1 and Lucky Placer Mining Claims in Table Rock district. H. H. Ray, superintendent, Howland Flat.

This company began work first at St. Louis about 1922. Operations gave disappointing results in the earlier years when previously drifted ground was piped. Early in 1925 control of the company passed to new interests. Since then a drain tunnel 1000 feet was completed, bedrock cuts were run and sluices installed and considerable gravel has been hydraulicked on the Wehrle property. Most of the piping was done in the season of 1927-1928, when 67,000 cubic yards were handled. Due to the expense of preliminary work mentioned, the returns so far have only in small part repaid the costs. The company pays for storage space for tailings behind Bullards Bar dam. Twelve men were employed in the 1927-1928 season and the water supply gave out about June 15.

*Lucky Gold Hill (Gold Hill or Lucky Hill) Prospect* is nearly mid-way between Poverty Hill and Port Wine, on the west or Canyon Creek side of the Howland Flat Ridge. Two prospect shafts and a short adit were run here in early days but no gravel has been mined. J. B. Lassiat had a crew of 10 men working on the claim late in 1928. A sawmill had been put up to supply lumber for buildings, and it was proposed to sink an incline after installing a hoist and pump, to be operated by a gasoline engine. As only rim gravel had been struck in the previous prospecting, the depth necessary to sink is uncertain.

*Monte Carlo Drift Prospect* in Clark Canyon was under lease and option during the past two years to the same people who have been prospecting the Rattlesnake. They have been running a prospecting adit, but had not found the channel in place at last report, although



this property, like the nearby Rattlesnake, has yielded small amounts of coarse gold at intervals during the past ten years.

*Montrose Mining & Development Company*, Downieville, has been preparing during the past season to work hydraulic ground on the North Fork of Yuba River between Secret and San Juan Canyons, three miles east of Downieville. They have installed pipe and monitor, and expect to take water for mining from San Juan Canyon, after the winter storms set in.

*Mt. Alta Drift Mine* is  $2\frac{1}{2}$  miles northeast of Pike and six miles by road from Camptonville, the nearest supply point.

It has been developed by a bedrock adit 3100 feet in length, entering in a side gulch near the north bank of Oregon Creek at an elevation of 3500 feet, and running northwest. This is in bedrock except at the face. A large part of the gravel so far opened had been worked previous to 1906 (when the above adit was started), through an old adit, but only about half of the 330 acres of locations has been prospected, according to Frank L. Sizer who made an examination and report upon the property.

The gravel is free wash and lies on a favorable slate bedrock, with a lava mud and boulder covering several hundred feet deep. It was mined to a height of  $4\frac{1}{2}$  feet above bedrock in the old workings. Sizer reported good grade gravel at the face, ranging in value from \$1.50 to \$5 per car of 20 cubic feet, but with only a small tonnage in sight.

There is a supply of water available in Marion Creek and two small reservoirs with combined capacity of 270,000 gallons above the tunnel level. C. N. Chatfield of Pike has worked the mine in a small way in recent years.

*Mt. Pleasant Mine*, comprising Ladies and Mt. Pleasant claims which contain about 400 acres, is in the Scales district, adjoining the Cleveland Mine on the east and Poverty Hill Mine on the southeast.

The Cleveland and Mt. Pleasant holdings together were estimated to contain 30,000,000 cubic yards of gravel available at once, with as much more ultimately available. No mining has been done on the Mt. Pleasant property.

In 1924 Frank Donohue prospected the ground with a Keystone drill. He reported the outside holes were 1200 feet apart on the east and west rims. One hole in the channel was reported 176 feet deep and all in gravel except 12 feet. This is said to have prospected well for hydraulicking all the way. Other holes were drilled after the property was visited, but it has lain idle since. Donohue claims that there is a length of about one mile of channel in the property. There is no mining equipment on the claims, and no water supply has been provided for yet.

*Mugwump Mines*. After the operation of Mugwump Mines Company between 1916 and 1923 (when the Gold Star and Young America gravel and quartz holdings near Forest were consolidated under the above name), the latter claims and the Live Yankee were taken under lease and option by *Diamond Peak Development Company*, a Nevada Corporation, who have since continued prospecting both the buried gravel channel and the quartz. The mines had been extensively worked



and are described in our past publications. The Young America adit had reached a length of over 3000 feet under the Mugwump Company. The gold occurred in a rather narrow pay streak, in a body of gravel having at times a width of one-fourth mile; the gold in the pay streak is coarse, much of it ranging from ten cents upward in value per piece. Outside the pay-streak the gravel is low grade, 6000 yards washed by the Mugwump Company yielding, it is reported, an average of \$1.70 a cubic yard, while the pay-streak was usually expected to average \$6 a cubic yard.

After retimbering the caved adit workings in 1923, the Diamond Peak Development Company found the pay streak 200 feet ahead, and in the course of their work produced a moderate sum. Lately they have been prospecting a quartz vein found about 1800 feet from the adit portal. Progress has been slow on this, as a small winze and drift below the adit level were run by hand.

The Mugwump ground adjoins the Oriental claims on the north, and the veins of the latter, once highly productive as a pocket mine, presumably extend into the Mugwump on the strike, but are buried under the lava capping.

*National Merger Gold Mines Company*, Lunsford Building, Reno, Nevada, holds by location the *Rattlesnake Group*, *Constance*, *Walker* and *Allen* placer claims, containing about 210 acres north of Goodyear Bar, and has leases and options on the *North Fork Group*, *North Fork Extension Group* and *Rambler Extension*, containing 180 acres. There has been no production by this company (See *Rattlesnake*).

*Pacific Group* of placer claims includes the Roscoe, Jennie Lind, Excelsior, Dreadnaught and Constitution,  $2\frac{1}{2}$  to three miles northeast of Port Wine on the east side of Howland Flat Ridge. (See claim map.)

In 1924 an adit was being run from the Clipper Ship to the Constitution and Roscoe claims by E. H. Wemple, but no production was recorded. In 1928, an adit in hard rock was under way. This is expected to be 1500 feet long before striking the channel. Late in the fall it was in about 500 feet but work was to be stopped when snow fell, as no provision had been made for winter. This adit is being driven under contract by a crew in charge of A. E. Albert, and it is expected that work will be resumed in the spring.

*Peterson Placer Claim* contains 20 acres, on the south side of North Fork of Yuba River adjoining Green & Farr's asbestos claims. It is probably on an old bench of the river. Old adits were driven, 600 to 2300 feet long. The claim is perhaps 1000 feet on the slope from the present river, on Hackman Hollow, which furnishes water for washing. Assessment work only.

*Pilot Drift Mine* (formerly *Mt. Vernon* and *Mott Tunnel Group*) is three miles south of Downieville by trail. It is under lease to Harkins and Maloney. In June, 1915 what was thought to be a new channel of rich gravel was found. Since then, different operators have prospected the property and have found baffling geologic conditions. Some coarse gold has been produced, it being claimed that one piece worth \$1,700 was stolen. The later work has been done through an adit 600 feet long and a raise 84 feet, with drifting on the upper level. According to Ross F. Taylor, the lava is 12 feet above bedrock, with sharp

broken rock on bedrock and washed gravel above. The property was not visited.

*Pleasant View Drift Mine* is on the east side of Marion Creek one-half mile west of the Mt. Alta mine. Little has been done at this mine in the past ten years, and the tunnel which is about 1800 feet long, (with a raise of 20 feet and an upper section) has been allowed to cave for an unknown length starting 400 feet from the portal. The gravel is free wash and has been profitably worked by Martin, O. D. Woodman and others but there is no record of the output; some of it paid \$4 to \$5 a cubic yard.

Water for washing is available in Marion Creek. There is a boarding house and bunk house, shop and some equipment.

*Poker Flat Drift Prospect* is at Poker Flat, four miles south of Table Rock, and at an elevation of 5030 feet.

Except for a deep lava-filled trough which is about 2000 feet wide where the creek crosses it at Poker Flat, Canyon Creek flows entirely on bedrock. Poker Flat Gold Gravel Mining Company spent \$65,000 prospecting for a gravel channel under this lava. A vertical shaft was sunk 537 feet. From a point in this shaft 505 feet deep, an incline was sunk at an angle of  $65^{\circ}$  to a depth of 675 feet. After driving 88 feet horizontally, an inclined winze was sunk 46 feet, giving a total vertical depth of 717 feet below the surface. The first incline from vertical shaft, and the horizontal drive of 88 feet, passed into and through what appeared to be either a projecting knob of serpentine bedrock on the uneven lava and bedrock contact, or a large detached mass; beyond this, to the north, in which direction they were driving, the lava and bedrock contact was still sloping steeply down when work stopped in January, 1914. During 1913, the water in the shaft is said to have suddenly sunk 100 feet, indicating a subterranean outlet.

The elevations at the bedrock in the various gravel mines to the northwest, south and southeast, with some of which any possible gravel deposit at Poker Flat would have to be correlated, are from 1300 to 1500 feet higher than the depth so far reached at Poker Flat (4313').

*Poverty Hill Mine* (Gold Valley) is reached by a road two miles long running west from the Scales-Port Wine road, and is four miles northeast of Scales.

The deposit is part of the main La Porte channel, occupying a curve. According to Lindgren, 'The channel was a well defined trough about 500 feet deep and one to two miles wide.' The trough is filled with blue gravel, cemented in places, with large boulders of quartz and slate. This is 10 to 30 feet deep. Above it is 100 to 120 feet of fine white quartz gravel and this is covered by white volcanic ash with some quartz pebbles, forming rolling hills, which are in part covered by later andesite. The bedrock in the hydraulic pit is soft hummocky schist and green porphyry. The old hydraulic pit in SW $\frac{1}{4}$  Sec. 32, T. 21 N., R. 9 E., is 2500 feet long by 625 to 1000 feet wide. The deep trough, said to be 150 feet wide, is reported to contain gravel which will average \$2 a cubic yard for a height of five or six feet.



A proposed bedrock tunnel to permit hydraulicking would have its portal on Gold Run Creek at an elevation of 4175 feet and would be 3000 feet long on a grade of five inches to 12 feet, with its face 37 feet below the gravel at the hydraulic pit. A water supply would have to be provided.

The last work was done in 1924, when Metals Exploration Company drilled part of the ground and obtained a permit to divert water from tributaries of Slate Creek. The project was later abandoned.

The army engineers in 1891<sup>1</sup> estimated that 2,250,000 cubic yards had been mined at Poverty Hill and that 4,000,000 cubic yards were then available. The holdings include the National Claim (90 acres) Gold Valley Placer Mine (138 acres) Forest King claim (110 acres) Impounding claim (32 acres) and one-half of Reservoir claim.

*Pride Hydraulic Mine* is five miles northeast of Sierra City on Deer Creek and Williams Creek and covers morainal material and gravel supposed to have been derived from the erosion of the channel passing the Hilda and Thousand and One Mines. *Bradley-Haley Company* (not incorporated) began work in 1923 but due to several seasons of short water supply have done little mining. Last season Ray Vandervoort, superintendent, stated they had water enough for only 100 hours work. Recently, *Paramount Mining Corporation* has been formed to work this and other property.

In October, 1928 preparations were being made for mining on Williams Creek. A cut was started on the contact of granodiorite and decomposed dike rock, thought to contain gold in addition to the placer gold in the gravel; this cut will also give grade for washing gravel. The bank is 30 to 70 feet high; at the present face, 35 feet. One and a half million yards of gravel are claimed to be available. Ten men are employed in the water season.

Water is taken from Deer and Williams Creeks under 380 feet head through ditches and 3000 feet of 22-inch to 11-inch pipe. The whole flow of both creeks is claimed and 1200 to 1500 inches is expected in a good season, from about April 1 to July 15, and under favorable conditions 1000 cubic yards may be piped in 10 hours. Boxes are 30 by 36 inches, with a grade of four inches in 14 feet, and a total length of 1200 feet. Sawed pine block riffles are used. There is a 25 h.p. hoist operated by water, for handling boulders.

*Rattlesnake Drift Prospect* is 13 miles by trail from Downieville, in Rattlesnake Canyon. It has been under option to various parties during the past few years, but only a relatively small amount of work has been done. (See *National Merger Gold Mines Co.*, lessee.)

In 1925 Dan McGonigal did some work but later interested the *Midway Divide Mining Company*. That company drove the adit ahead during 1926, at which time 800 feet had been run, with raises and crosscut. Though prospects were found, it appeared as if this gravel was not in place, but had been pushed out of the channel by the lava, and then covered by another layer of lava mud. This company quit late in 1926. Work was begun in the spring of 1928 by the present lessees on a new and lower adit, but after driving only a

<sup>1</sup>House Ex. Doc. 267, 51st Cong; 2d session, p. 83, 1891.



short distance work was suspended late in the fall, to be resumed in the spring of 1929.

*St. Charles Hill Mining Company* was incorporated in 1915 and carried on development at intervals until late in 1926. The ground is patented, including about 300 acres of placer and two quartz claims, the Cleveland and Kentucky. The work being done at that time was described in the seventeenth report. Part of the channel, downstream from the recent work, was worked many years ago until a fault was encountered which is said to have dropped the upstream segment about 38 feet. Since 1915, an adit has been run over 1100 feet, and raises have been put up, from which the channel has been prospected and the position of rims determined. This adit entered about 700 feet upstream from the face of the old workings, and in all about 3000 feet of underground work has been done by the present company. There has been no production in later years.

The company plans running a new adit from Fiddle Creek, and it is thought this will tap the channel in 500 to 600 feet. The other workings have been abandoned.

*Snowden Hill Drift Mine* (formerly *Watts Mine*) was last worked between 1909 and 1914 with F. J. Joubert as superintendent. A new adit was run ten feet below the old one; 600 feet in, they raised 21 feet, crosscut 300 feet and drifted upstream on the channel, about 1800 feet, according to Joubert. The channel is very rocky, containing two cars or more of boulders to each car of gravel. The distribution of pay was spotted; in places it ranged from \$4 to \$9 gold per cubic yard, and one body of gravel averaging \$6 a cubic yard yielded \$10,000. Taken as a whole, however, the operations were said to have been disappointing. There is supposed to be a large body of gravel left which possibly might be made to yield a profit if worked under the most favorable and economical conditions. The deposit is believed to be part of an old bench of the present North Yuba River, which is now 1000 feet lower. There are some good buildings on the property.

*Otto Strand*, Goodyears Bar, owns a gravel claim adjoining the Kirkpatrick group, about two miles south of Goodyears Bar. He has an adit about 200 feet long, going downstream in a southerly direction on a channel west of the Kirkpatrick. The water supply used at the latter mine comes from Strand's ground.

He also owns two quartz claims a mile and a half east of Goodyears Bar. These cover old pocket mine workings. A vein reported to be  $3\frac{1}{2}$  feet wide in a winze 40 feet deep. is being prospected further by an adit now 114 feet long (April 1, 1929).

*Table Rock Mining Co.* has a lease and option to purchase the Table Rock and California Consolidated claims on the south side of Table Rock, a mile and a half south of Howland Flat.

The old California diggings included both hydraulic and drift mining. The lava of Table Rock separates the gravel from that of Howland Flat, and it has been considered likely that the Deadwood gravel south of Canyon Creek may have formerly been connected with the California diggings, in which case the two may have been on a branch of the Port Wine Channel.

The present company began work in July, 1928, and have been extending a tunnel previously run 900 feet. It was thought this would have to be run 700 feet farther before striking the channel. The work was being done by hand and six men were employed in October, 1928.

*Thousand and One Drift Mine* is four miles from Bassett Station via the Pride Mine. W. H. Pettee, who was associated with J. D. Whitney nearly 60 years ago in making a geologic survey of the state, visited and described the property and workings in part as follows:

"The tunnel is not driven upon or through a sloping rim rock; if there is a true channel here, the tunnel follows its bed, or nearly so \* \* \* 335 feet from the portal, the tunnel branched and an air shaft was started \* \* \* bedrock pitches down \* \* \* by lowering the tunnel four feet, the lowest point could be drained. \* \* \* The gravel is made up of volcanic and granitic pebbles and boulders, with occasional bunches of micaceous sand and some carbonized wood. \* \* \* The boulders are of all sizes up to six or eight feet through. I saw no quartz pebbles at all, with the possible exception of a few very small ones. The boulders are usually well rounded. \* \* \* It is evident that the channel—if one exists—was formed and filled under quite different conditions from those which prevailed at the time of the formation of the lower channels. \* \* \* Some coarse gold has been found in this gravel, but I have no information as to its amount."

The channel, and a so-called front channel (the latter no doubt being the one described by Pettee) have since been regarded by geologists as the same mined at the Hilda property, two miles northwest of Milton; and it is supposed by Turner to have flowed north from Chips' Hill to Haskell Peak, the lower elevation at Chips' Hill being attributed to faulting. The Pride Hydraulic Mine is claimed to be on the eroded section of this channel to the north.

The mine was not visited, and the following details of underground workings were supplied by Serphy Terry, president and manager.

No. 1 adit, 375 feet long, runs through the granodiorite contact and enters the so-called 'front channel.'

No. 2 or Coffin adit went through the 'front channel' and cut the rim of the main channel at about 700 feet, then was drifted north in rim gravel for 900 feet, and a short distance east. This was all done years ago, and has not been worked by the present operators, although it is mostly open and is said to show good prospects. Considerable breasting was done formerly. It was six feet too high to bottom the channel.

No. 3, the original adit, is caved and inaccessible. It is said to have been 800 feet long including several hundred feet of breasting upstream.

No. 4, or Gorham adit, was originally run 703 feet. It was reopened by the present operators for 400 feet and the floor was taken up to give sufficient depth. They ran 240 feet north and mined and washed a few hundred carloads of gravel from the 'front channel' which yielded a small amount of gold but was not of as good grade as anticipated by them. Returning to the 400-ft. point they later began running north and late in March, 1929, had gone 210 feet in the direction where the main channel is expected.

Since work began in 1928, a first-class three-story camp building has been erected, as well as a blacksmith shop, snowshed and mill building. There is a Pelton wheel and blower for mine ventilation. For washing the cemented gravel a disintegrator, or trommel with liners of angle iron and a capacity of 200 cubic yards daily, was installed. The water supply is limited, and is conserved in seven redwood tanks of 58,000 gallons total capacity.

TABLE OF PLACER MINES AND PROSPECTS, SIERRA COUNTY

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Agate	13	21 N.	12 E.	Maschella, San Francisco	7,100		XI, p. 322; XII, p. 221; XIII, p. 371; M. M. R. Sierra, p. 134
Alturas	11, 14	21 N.	9 E.		4,000		
	15, 21	21 N.	9 E.				
	22, 23	21 N.	9 E.				
American Hill	28	19 N.	11 E.	Dos Pesos Estate, New York American Mng. & Dev. Co.	4,500	263	M. M. R. Sierra, p. 134
American Mng. & Dev. Co.	14, 15	19 N.	9 E.			175	
Argentine, Never Sweat & Germania				Mrs. J. E. Westall, et al., Sierra City			See Wide Awake
Ariel		20 N.	9 E.			101	
Arizona, et al.				Hugh McCormick, Downieville			XVII, p. 476
Associated Mines, Inc.				F. P. Morrill, 1538 Henry st., Berkeley			See Blue Gravel Mines, Cons.
Associated	17	20 N.	10 E.	Jensen, Downieville			See Hilo
Badger Hill	35	20 N.	10 E.	Bald Mountain Mng. Co., Est. of Jas. McGregor,	3,000		M. M. R. Sierra, p. 31
Bald Mountain	22, 28	19 N.	10 E.	Downieville; Mrs. S. V. Heinzen, Browns Valley	4,637	441	IX, pp. 120-121; M. M. R. Sierra, pp. 31-33; Bull. 92, p. 126
Bald Mountain Extension	22, 23	19 N.	10 E.	Bald Mtn. Extension G. Mng. Co., Downieville; John Costa, Pres.	4,300		VIII, pp. 580-581; XI, pp. 408-409; XII, p. 261; XIII, p. 371; M. M. R. Sierra, p. 33
Bald Top	27	20 N.	9 E.	J. M. McMahon, Supt. for company			M. M. R. Sierra, p. 34
Balsam Flat	2	18 N.	10 E.	Captain Morrill, Allegheny			
Bella Union Cons.	34	21 N.	9 E.	Mrs. J. E. Westall, Sierra City	4,500		M. M. R. Sierra, p. 78; XX, p. 365
	3	20 N.	9 E.	Bellevue Mng. Co., R. H. Kingdon, Agt., La Porte			M. M. R. Sierra, p. 34
	19, 26	22 N.	9 E.				
	22 N.	22 N.	9 E.				
	30, 25	22 N.	9 E.				
Bellevue	36	22 N.	9 E.		4,700	723	
Big Flat	29	20 N.	10 E.	W. W. Casserly, Goodyear Bar			M. M. R. Sierra, p. 134
Black Bear	29	20 N.	10 E.	H. S. Tibbey, et al., Downieville	2,900		
Blue Channel Mng. Co.	4, 9	20 N.	10 E.	Blue Channel Mng. Co.		240	See Telegraph (qtz.)
Blue Gravel (Bonanza Cln.)	33	21 N.	9 E.	C. A. Edgar & Wife, O. C. Ermatinger, Scales		35	M. M. R. Sierra, p. 35
	4	20 N.	9 E.	Blue Gravel Mines Cons., W. W. Charles, Pres., 1200 S. Hill st., Los Angeles Richard Kingdon, et al., owners; Blue Gravel Mines Cons., lease & option			See Iowa, Hardscrabble, Bella Union, et al. M. M. R. Sierra, p. 134; XX, p. 365
Blue Gravel Mines Cons.	3, 4	20 N.	9 E.				
	33, 34	21 N.	9 E.				
Bon Ton Cons.	35	21 N.	9 E.				



Boston		See Manchester	
Boulder Bar	28	A. R. Koehler, La Porte	M. M. R. Sierra, p. 134
Bradley Cons. Group	6, 7	Bradley Cons. Group	XII, p. 262; XIII, p. 372; M. M. R. Sierra, pp. 66-67
Brown Bear	13, 24	Brandy City Mng. Co., Rm. 414, 216 Pine st., San Francisco	M. M. R. Sierra, p. 34; XVII, p. 476
Bruckermann	18, 19	H. Tibbey, Downville, et al.	XIII, p. 372; M. M. R. Sierra, p. 34
Buckeye	3	F. W. and G. A. Bruckermann, 1358 Fifteenth ave., San Francisco	XI, p. 408; M. M. R. Sierra, pp. 34-35
Bunker Hill	31	Buckeye Mng. Co., Albert Read, Pres., Alleghany; E. L. Crafts & E. R. Jones, Forest City; John Walsh	See Blue Channel Mng. Co. XII, p. 263; XIII, p. 373; M. M. R. Sierra, p. 35
Bunker Hill	21	Lloyd & Andrews, Port Wine	M. M. R. Sierra, p. 35
Burlington	27	John Freeman, Sierra City	M. M. R. Sierra, p. 135
Burnham Cons.	2	W. T. Burnham	M. M. R. Sierra, p. 68; XX, p. 366
Caledonia	5, 8	Est. of M. M. McBride, c/o A. P. Block, 114 Sansome st., San Francisco	M. M. R. Sierra, p. 35
Calif. Cons.	12	M. McDonnell & Bros., Table Rock (see also Table Rock)	M. M. R. Sierra, p. 35
Campbell	5	Ada L. Jones, 2220 Ward st., Berkeley	M. M. R. Sierra, p. 35; XX, p. 365
Canada Mng. Co.	At Poverty Point	O. F. Cayea & Sherman Est.	M. M. R. Sierra, p. 35
Captain Cook	13	Albert Hough, 3723 Woodruff ave., Oakland	M. M. R. Sierra, p. 35
Carleton	15	Edwards Brothers	M. M. R. Sierra, p. 35
Carmen	3	J. J. Johnson, San Jose	M. M. R. Sierra, p. 37; XX, p. 366
Challenge	15, 21	L. F. Fournier & J. Burne, Sierra City	M. M. R. Sierra (Neocene P. M. Co.) pp. 72-73; XX, p. 363
Charcoal Ranch	13, 14	L. M. Stiles, Del Norte Hotel, El Paso, Tex.	XII, p. 263; XIII, p. 374; M. M. R. Sierra, p. 36; XX, p. 366
Cleveland, et al.	36	Clipper Ship Mng. Co., E. H. Wemple, c/o Judge C. A. Odell, Agt., Richmond	M. M. R. Sierra, p. 135
Cleveland, et al.	17, 18	W. L. Wilson, Downville	M. M. R. Sierra, p. 36
Clipper Ship	20 N.	Columbia Channel Gold Mng. Co., John C. Newlands, Secy., Sharon Bldg., San Francisco	
Cold Spring Gr.	7	T. C. Corlett, Table Rock	
Columbia Channel	12		
	14, 15		
	20, 21		
	22, 28		
	29		
	24		
Comrade	21 N.		
Conglomerate	13		

Names and addresses of owners shown herein are those given in county tax records. The names and ownerships of many idle mines have changed but are given to facilitate reference to the old reports.

TABLE OF PLACER MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Cortoman.....	28, 29 32, 33 12	19 N. 19 N. 20 N.	10 E. 10 E. 10 E.	Jessie A. Rea, Growers Bank Bldg., San Jose..... W. H. Spaulding, 14 Sansome st., San Francisco. Sinnott and Carmichael, Gibsonville.....	4,500 6,000 5,575	197 120 115	M. M. R. Sierra, p. 37 XII, p. 263; XIII, p. 374 XIII, pp. 374-375; M. M. R. Sierra, p. 37
Dead River (see under qtz.).....	33, 34	19 N.	10 E.	Stanley Weiland, Scranton, Pa.....			M. M. R. Sierra, p. 37; XVIII, pp. 502- 503; XX, p. 18
Deal.....							See Rattlesnake
Deer Group.....	31	21 N.	12 E.	E. A. & J. O. Hayes, San Jose.....		160	M. M. R. Sierra, p. 135
Depot Hill.....	19	19 N.	9 E.	Frederick Joubert, Comptonville.....	3,100	60	XII, p. 204; XIII, p. 375
Diana Mng. Co.....	29	22 N.	10 E.	Diana Mng. Co., Merchants Exchange Bldg., San Francisco			M. M. R. Sierra, p. 135
Diana, et al.....				C. B. Wingate, 321 El Cerrito ave., Piedmont		160	
Dragon Fly.....	33	21 N.	11 E.	N. H. Squire & C. J. Simmons, Downieville.....	5,000		M. M. R. Sierra, p. 135
Eagle.....	23	21 N.	9 E.	Liberty heirs & Dr. Hopkins.....	4,890		VIII, p. 579; XI, p. 418; M. M. R. Sierra, p. 37; XX, p. 365
Empire.....	19	22 N.	9 E.	E. G. Squire, Willows.....	5,495		M. M. R. Sierra, p. 37
Erie.....	23	21 N.	9 E.	Mrs. M. J. France, M. R. A., Marysville, or La Porte	4,880		M. M. R. Sierra, p. 37; XX, p. 365
Erwin.....	17	20 N.	10 E.	Wm. Erwin, Downieville, et al.; Chas. Herron, lessee, Downieville	4,900		M. M. R. Sierra, p. 37
Eureka.....	7	20 N.	10 E.	Spaulding, Costa, et al., Downieville.....	4,800		XIII, p. 375
Excelsior.....	12, 13	21 N.	9 E.	Excelsior Drift G. Mng. Co., Grace L. Tribe, 3342 Fourth ave., Sacramento	5,500	112	XII, p. 265; XIII, p. 376; M. M. R. Sierra, p. 38, XX, p. 366
Excelsior (St. Lawrence & Empire).....	15	20 N.	10 E.	John Costa, M. A. Costa, Downieville.....	4,950	860	XIII, p. 375; M. M. R. Sierra, pp. 69-70
Excelsior Gr.....	29	9 N.	11 E.	Frank Montre, F. Tanguay & J. Merhan, Forest.....	5,000		XII, p. 267; XIII, p. 378; M. M. R. Sierra, p. 36
Excelsior.....						108	XI, p. 412
Excelsior & White Bear.....							F. R.
Fair Play.....							Part of Cleveland Cons.
Feather Fork.....	25, 36	22 N.	10 E.	W. C. Wingate, Downieville.....			XI, p. 419; XII, p. 265; XIII, p. 376; M. M. R. Sierra, p. 38
First Chance, et al.....	Partly in Slate	Sierra	on Creek	C. B. Wingate, c/o R. H. Kingdon, La Porte.....			

Flanagan	22, 30	22 N.	10 E.	Anna E. Flanagan, La Porte	260	M. M. R. Sierra, p. 35
Forest Queen Mng. Co.	23	21 N.	10 E.	Forest Queen Mng. Co., P. L. Carmichael, Pres.; J. K. Wall, Secy.		
Fordham Group				L. H. Fordham, c/o Murphy & Wood, Arkansas Trust Bldg., Hot Springs, Ark.		
Forest & Queen				H. Skinner, Gibsonville		See Forest Queen Mng. Co.
Garnet	21	22 N.	10 E.	A. Humphreys, et al., 1411 Oak st., South Pasadena	6,000	M. M. R. Sierra, p. 38
Gentile Flat	32	20 N.	12 E.	Gibraltar Cons. G. Mng. Co., Downieville. Lease	6,500	M. M. R. Sierra, p. 39; XVII, p. 476
Gibraltar	7	21 N.	10 E.	with option to Gibraltar-Sierra Mng. Co., 928 Commercial Savings Bank Bldg., Stockton		
Gibsonville Cons.	16, 17	22 N.	10 E.	Gibsonville Cons. Pl. Mines, Marsh-Strong Bldg., Los Angeles		
	19, 20	22 N.	10 E.			
	30					
Gibsonville Water & Mng. Co.	21	22 N.	10 E.	G. N. Cox, Agent, Table Rock	6,000	XII, p. 266; XIII, p. 376
Golden Era	18	21 N.	10 E.	Richard Moore	103	M. M. R. Sierra, p. 135
Golden Hope	35	19 N.	10 E.	C. E. Mott, Forest	4,000	M. M. R. Sierra, p. 39
Golden Scepter	22	21 N.	10 E.	G. A. Maxwell, Continental Bldg., San Francisco		M. M. R. Sierra, p. 136
Gold Hill Gr.						See Lucky Gold Hill
Gold Star						See Hanley & Co.
Gold Star	32, 33	19 N.	10 E.	Gold Star Mines Co., Box 1102, Sacramento	4,500	M. M. R. Sierra, pp. 40-41
Goodyear Bar				Marion F. Lusk, Downieville		
Goodyear Bar	5	19 N.	10 E.	Goodyear Bar Placer Co., c/o Mark Averill, 1608 Webster st., Oakland	47	
Gold Valley						See Poverty Hill Mines
Greenwood Mng. & Dev. Co.	12	21 N.	9 E.	Greenwood Mng. & Dev. Co., Port Wine		M. M. R. Sierra, p. 41
Grizzly Hill				C. M. Turner & W. A. Hoff, Dobbins		
Halkyard, et al.	29	19 N.	9 E.	Jos. Halkyard & M. G. Calvin, Camptonville, owners. B. F. McNaught, Camptonville, or 306 E. Colorado st., Glendale, et 24 al., lessees	3,580	
Halsey Group				W. D. O'Brien, 718 Monadnock Bldg., San Francisco		XII, p. 273; XIII, p. 384; M. M. R. Sierra, p. 42
Hal Taber	19	22 N.	9 E.	W. H. Spencer, Hal P. Taber, La Porte	5,340	XII, p. 273; XIII, p. 384; M. M. R. Sierra, p. 42
Hanley & Co.	32, 33	19 N.	10 E.	Mrs. Hanley & Son, Alleghany		XII, p. 267; XIII, p. 378; M. M. R. Sierra, p. 42
Happy Camp	15	19 N.	10 E.	John Nipp, owner, Goodyear Bar		
Happy-Go-Lucky	11	21 N.	10 E.	W. S. Chestain, Table Rock via La Porte	5,500	

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TABLE OF PLACER MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Happy Hollow Group-----	29	22 N.	10 E.	Catherine M. F. Judge, 935 Jones st., Reno-----	5,600	-----	XII, p. 274; XIII, p. 384; M. M. R. Sierra, p. 61 XX, p. 364
Hardscrabble-----	3	20 N.	9 E.	Mrs. Alice S. Brown, 2416 McKinley ave., Berkeley, et al. Option to Blue Gravel Mines Cons.	-----	-----	See Excelsior Group See Winkeye M. M. R. Sierra, p. 136 See Flanagan
Hawkeye & Bell Group-----	34	21 N.	9 E.	-----	-----	-----	-----
Hawkeye & Pittsburg-----	31	22 N.	10 E.	Ah Gook, Table Rock-----	5,600	-----	-----
Hayes-----	27, 22	21 N.	10 E.	Chas. W. Kitts, 1248 Twenty-fifth ave., San Fran- cisco	6,500	38	-----
Helena-----	22	21 N.	10 E.	Hidden Nugget P. Mng. Co., 810 Electric Bldg., San Francisco	-----	11	M. M. R. Sierra, pp. 42-43
Herkimer (Oro Puro)-----	14	18 N.	9 E.	-----	-----	-----	-----
Herkimer & Bunker Hill-----	10	21 N.	10 E.	Chas. F. Bettinger, Table Rock via La Porte-----	5,050	-----	-----
Hidden Treasure-----	24	21 N.	9 E.	Highland Mary Mng. Co., La Porte-----	-----	-----	-----
Highland Mary-----	2, 3	19 N.	12 E.	Hilda Gold Mng. Co., 948 Market st., San Francisco	6,500	-----	XVII, pp. 476-477
Hilda-----	35	20 N.	12 E.	-----	-----	-----	-----
Hilo-----	17	20 N.	10 E.	Bernhardt Bros., Downieville-----	-----	-----	XVII, p. 477
Hobby-----	17	19 N.	9 E.	M. W. Hobby, Camptonville-----	-----	-----	M. M. R. Sierra, p. 136
Homestake-----	14	21 N.	12 E.	Atkinson Bros., Camptonville (1918)	-----	-----	XIII, p. 378
Homestake-----	21	22 N.	10 E.	H. Forbes, Gibsonville-----	5,900	-----	M. M. R. Sierra, p. 43
Hustler-----	16, 18	19 N.	9 E.	C. A. Reid, Bangor-----	2,800	-----	M. M. R. Sierra, p. 43
Indian Hill-----	19, 20	19 N.	9 E.	Yuba River Power Co., Rm. 725, 225 Bush st., San Francisco. F. G. Morgan, lessee. F. W. Camp, Camptonville, sub-lessee	-----	-----	-----
Iowa-----	5	20 N.	9 E.	Oakland Bank of Savings, Oakland, owner. Option to Blue Gravel Mines, Cons.	5,000	400	M. M. R. Sierra, pp. 43-44
I. X. L. & South I. X. L. Group-----	33	22 N.	10 E.	Louisa Hayes, 803 Lincoln st., Oroville-----	-----	-----	M. M. R. Sierra, p. 136 See Depot Hill
Joubert-----	1	18 N.	9 E.	Mark N. Alling, Southern Hotel, Bakersfield; Ross L. & Ella M. Taylor, et al., Downieville	4,050	-----	M. M. R. Sierra, pp. 44-45
Kanaka Mine-----	36	19 N.	8 E.	-----	-----	-----	-----
-----	31	19 N.	10 E.	-----	-----	-----	-----
-----	6	18 N.	10 E.	-----	-----	-----	-----
Kirkpatrick-----	15	19 N.	10 E.	Kirkpatrick Mines, Chas. G. Johnson, St. Treasurer, Sacramento, et al.	-----	-----	M. M. R. Sierra, p. 71; XVII, p. 477

Klondike.....	3	19 N.	12 E.	W. W. Turner, Mgr.	-----	-----	M. M. R. Sierra, p. 45
Kosmos & Keystone Ext.....	3, 4	21 N.	10 E.	Henry Hollweg, La Porte	-----	-----	-----
Ladies.....	5, 8	20 N.	9 E.	-----	-----	-----	Part of Mount Pleasant
Ladies Canyon.....	13	20 N.	11 E.	J. Laveroni, J. & T. Costa, Downieville.	6,500	-----	M. M. R. Sierra, p. 71
Last Chance.....	9	19 N.	10 E.	W. B. & D. E. Owens, Goodyear Bar	4,500	-----	XIII, p. 379; M. M. R. Sierra, p. 45
Last Chance.....	32	22 N.	10 E.	T. Donohue, St. Louis; J. F. Cowdery	5,600	-----	-----
Last Chance.....	5	21 N.	10 E.	-----	-----	-----	-----
Last Resort.....	-----	-----	-----	-----	-----	-----	See Sebastopol Mine
Little Grizzly.....	23	21 N.	10 E.	Charles Kelles, Downieville	6,200	-----	M. M. R. Sierra, p. 45
Lincoln.....	-----	-----	-----	-----	-----	332	Part of Cleveland Cons.
Lincoln Placers.....	31	20 N.	11 E.	Lincoln Placers, Inc., Chas. L. Nichols, 1408 Chap-	-----	-----	-----
Lincoln & Virginia.....	35, 36	20 N.	10 E.	man Bldg., Los Angeles	-----	-----	-----
Lost River.....	4	21	10	Potosi Mng. Co., H. R. Fowler, Supt.	-----	-----	-----
-----	4	19 N.	9 E.	Mark N. Alling, Southern Hotel, Bakersfield; Emeline A. Alling, Downieville; Geo. F. Taylor, W. I.	4,015	1,340	XII, p. 271; XIII, p. 382; M. M. R.
-----	28, 33	20 N.	9 E.	& Lena A. Redding, et al.	-----	-----	Sierra, pp. 45-47
Lucky Boy.....	In Indian Creek	-----	-----	M. E. Whitlum, Camptonville.	-----	-----	-----
Lucky Dog.....	29	19 N.	10 E.	Frank & Wm. Davies, Forest; Thos. Fitzgerald, J. B. Moulton, E. R. Jones	4,500	150	XII, p. 268; XIII, p. 379; M. M. R.
Lucky Gold Hill.....	34	21 N.	9 E.	John Lassiatt, 6437 Harrison Court, Oakland, or La Porte	4,500	320	Sierra, p. 47
Lucky Hill.....	-----	-----	-----	-----	-----	-----	M. M. R. Sierra, pp. 39-40; XX, p. 365
Mabel Mertz.....	29, 30	19 N.	11 E.	Forest City Mng. Co., Downieville; H. B. McCormick, Downieville, Secy.	4,800	-----	See Lucky Gold Hill
Mammoth Springs.....	23, 26	19 N.	10 E.	Milton Davis, Forest	5,500	510	M. M. R. Sierra, pp. 47-48
Manchester.....	21	22 N.	10 E.	Belle C. & Wm. S. Brown, 2103 Van Ness ave., San Francisco	6,100	19	XII, p. 268; XIII, p. 379; M. M. R.
Manxman & Bluebell.....	-----	-----	-----	-----	-----	-----	Sierra, pp. 48 & 100-101
Marguerite.....	Gibsonville	-----	-----	-----	-----	-----	M. M. R. Sierra, p. 48
Mayday & Undine.....	13, 14	21 N.	12 E.	Stefanno Vrenno, 935 Jones st., Reno.	-----	-----	See Scott Mine
-----	24	21 N.	12 E.	H. H. Meyer & Estates of James McGregor & E. L. Case, Downieville	-----	39	M. M. R. Sierra, p. 71
Michigan.....	20	22 N.	10 E.	L. L. Clough, 2/9, Quincy; Lois McDaniel, 2/9, 815 Seventh st., Marysville	-----	-----	M. M. R. Sierra, p. 136
Midas.....	5	21 N.	10 E.	C. W. Cox, Table Rock	5,000	-----	XI, p. 412; M. M. R. Sierra, p. 48
Middle Yuba.....	15, 16	18 N.	9 E.	Poorman & Hastings, 1724 Santa Clara ave., Alameda	-----	90	M. M. R. Sierra, p. 136
-----	20, 21	18 N.	9 E.	-----	-----	-----	-----
-----	22	18 N.	9 E.	-----	-----	-----	-----
Miner's Home.....	5	21 N.	10 E.	Howland Flat Mines Co., c/o C. L. Faulck, Wood-leaf	-----	155	M. M. R. Sierra, pp. 48-50; XX, p. 366

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TABLE OF PLACER MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Monte Carlo.....	26	21 N.	10 E.	A. Lavezola, Steve Dondero & Poggi, Downieville.			M. M. R. Sierra, p. 50; XVII, p. 477
Monterey.....							See Lost River
Morristown & Angora Group.....	24	21 N.	9 E.	A. Harris, La Porte.	5,000	400	M. M. R. Sierra, p. 50
	30	21 N.	10 E.				
Mott Mine.....	12	19 N.	10 E.	Mott & Morrison, Forest; Harlan, San Jose.			M. M. R. Sierra, p. 51
Mott & Brady Group.....	11	19 N.	10 E.	C. E. Mott, Forest.	5,000		M. M. R. Sierra, p. 51
Mount Alta.....	33	19 N.	9 E.	Mrs. R. M. St. Claire, 421 Fifth st., Marysville; C. N. Chatfield, Pike			M. M. R. Sierra, p. 53; XVII, p. 477
Mount Pleasant.....	5, 8, 9	20 N.	9 E.	Kate Donohue, 396 Hayes st., San Francisco.		417	
Mountain Boy.....	At Bunker Hill			Frank Prosser, Martinez.			
Mountain House.....	18, 19	19 N.	10 E.	W. J. Belcher, W. E. Caserly, G. W. Voelzel & Mark Alling	4,720		M. M. R. Sierra, pp. 51-52
	30	19 N.	10 E.				
	25	19 N.	9 E.				
Mountain Lion.....				J. H. Williams, N. Columbia.			
Mountain View.....	24	19 N.	10 E.	Wayland, Alleghany.			M. M. R. Sierra, p. 52
Mountain View Cons. Group.....	30	21 N.	10 E.	Messery & Shield, La Porte.			M. M. R. Sierra, p. 52
Mount Rainier.....	8, 9	18 N.	10 E.	Jos. J. McCullough, N. San Juan.			M. M. R. Sierra, p. 137
Mount Vernon & Mott Tunnel Group (Pilot).....	12	19 N.	10 E.	Midway Divide Mng. Co. Leased to Harkins & Maloney	5,000		M. M. R. Sierra, pp. 52-53
Mugginsville.....	18	20 N.	10 E.	W. A. Morse, Downieville.	5,000		X, pp. 577-578, 643-647; XI, p. 407; XII, p. 275; XIII, p. 384; M. M. R. Sierra, pp. 53, 133-134; XVIII, pp. 143, 147; Pre. Rep. No. 8, p. 39
Mugwump.....	28, 33	19 N.	10 E.	Mugwump Mines Co., S. L. Bright, San Francisco; A. D. Foote, C. F. Clinch & A. H. Tickell, Grass Valley, et al.			See Washington See Cleveland
National.....				Neocene P. Mng. Co., 5630 Tryon rd., Los Angeles.		104	
Neocene.....	Lots 62, 63	20 N.	9 E.				
New Council Hill, Alturas Ext. & Fairplay 1, 2, 3.....	Lots 48-56 incl.	20 N.	9 E.	A. C. Stiles, 204 Mills Bldg., El Paso, Tex.; F. R. Wehe, 74 New Montgomery st., San Francisco			
New Jersey.....	31	19 N.	10 E.	A. Eckhart, 531 Dolores st., San Francisco.			M. M. R. Sierra, p. 53
New York.....	13, 24 et al.	21 N.	12 E.	Hugh & Westall Estate, Sierra City	6,800	300	XIII, p. 378
North American Cons.....	30	22 N.	10 E.	North American Cons. Mng. Co., Garden City Bank Bldg., San Jose			



North Fork.....							See Wisconsin North Fork
Nugget Nell.....	4	20 N.	10 E.			400	M. M. R. Sierra, p. 53; XVII, p. 477
Occidental.....							M. M. R. Sierra, p. 53
Old Colony.....	nr Kipatriek						
Omega.....	29	19 N.	10 E.				M. M. R. Sierra, p. 137
Orient Group.....	31, 32	19 N.	9 E.			3,800	M. M. R. Sierra, pp. 53-54; XX, p. 18
Pacific Gr.....	18	21 N.	10 E.			5,000	M. M. R. Sierra, p. 54
Pennsylvania.....	2	21 N.	10 E.				M. M. R. Sierra, p. 54
Pennsylvania.....	32	22 N.	10 E.			11	M. M. R. Sierra, p. 137
Peterson.....	33	20 N.	12 E.			20	See Slate Creek
Phil Doris.....							
Pig Canyon.....	10	20 N.	11 E.				M. M. R. Sierra, p. 137
Pilot Peak, et al.....	20	22 N.	10 E.				See Hayes
Pine Grove.....							XI, p. 412; XII, p. 270; XIII, p. 381;
Pioneer.....	13, 14	21 N.	9 E.			360	M. M. R. Sierra, p. 54; XX, p. 365
	23, 24	21 N.	9 E.			220	M. M. R. Sierra, pp. 54-55
Pleasant View.....							
Poker Flat.....	10	21 N.	10 E.			120	M. M. R. Sierra, p. 55
Poor Boy.....	32	20 N.	10 E.			80	M. M. R. Sierra, p. 137; XX, p. 365
Poor Boy Cons.....	34	21 N.	9 E.			2,900	M. M. R. Sierra, p. 55; XVII, p. 477;
	3	20 N.	9 E.			4,825	XX, p. 365
Port Wine Cons.....	13, 14	21 N.	9 E.				
	18	21 N.	10 E.				
Poverty Hill.....	32	21 N.	9 E.			569	U. S. G. S. P. P. 73, p. 100
	5	20 N.	9 E.				
Pride Hyd.....	11, 13	20 N.	12 E.				
	14	20 N.	12 E.				
Pyro.....	3, 4	21 N.	10 E.			650	M. M. R. Sierra, p. 56
Rattlesnake.....	7, 18	20 N.	11 E.				M. M. R. Sierra, p. 56
							XII, p. 270; XIII, p. 382
Reese Ravine.....	22	21 N.	10 E.				
Renaissance.....	3	21 N.	10 E.			5,800	
Rifle.....							
Riley.....							M. M. R. Sierra, p. 56

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TABLE OF PLACER MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Rocky Peak	10, 11	19 N.	10 E.	Estate of E. L. Case, Downieville	4,500		See Lost River XI, p. 406; XII, p. 271; XIII, p. 382; M. M. R. Sierra, pp. 56-57; Bull. 92, p. 126
Ruby	14, 15	19 N.	10 E.				
Russell Hill	19	19 N.	9 E.	W. S. Russell, Camptonville			XII, p. 272; XIII, p. 382; M. M. R. Sierra, p. 57
Scott	2, 3	21 N.	10 E.	Jas. Scott & Bros., P. L. Carmichael & J. C. Poor, Table Rock	6,000	400	M. M. R. Sierra, pp. 57-58
Sebastopol	1½ mi.	Poker	Flat	Reese Ravine Mng. Co., 655 Congress st., Portland, Me.			
Shirley				Lillian Gatin, 1030 Post st., San Francisco			See Miner's Home
Shotgun	5, 6	18 N.	11 E.	Sierra-Gold Placer Mng. Co., Winston-Salem, N. C.		320	
Sierra	31, 32	19 N.	10 E.	M. W. Davis, et al.		270	M. M. R. Sierra, p. 58
Sierra Geneva	12	21 N.	9 E.	J. H. Thomas, Oakland; T. Donohue Estate, San Francisco	5,050		
Sierra Union				C. A. Reed, Bangor			XIII, p. 382; M. M. R. Sierra, p. 137
Slate Creek	36	22 N.	9 E.				
	1, 11	31	22 N.				
	31	21 N.	9 E.	J. H. Thomas, Oakland			M. M. R. Sierra, p. 137
Slate Creek Debris Dam Co.	10	20 N.	11 E.	Dan R. Thompson, Sierra City	6,000		
Smith				Rose Conlan, St. Louis, Cal.			M. M. R. Sierra, p. 58
Smith & Brundage Group	11, 14	19 N.	9 E.	C. T. Driscoll, trustee, Mission San Jose, Alameda Co.		91	See Watts
Snowden Hill	15	19 N.	9 E.	M. M. Marshall, 655 Congress st., Portland, Me.	6,200		
Soldier Boy	15	21 N.	10 E.	United Eastern Mng. Co., Los Angeles, lessee.	5,500	800	M. M. R. Sierra, p. 137
South Fork	22, 23	19 N.	10 E.				XII, p. 272; XIII, p. 383; M. M. R.
	27	19 N.	10 E.				Sierra, pp. 58-59
St. Charles Hill Group	25, 26	20 N.	9 E.	Frank R. Wehe, 74 New Montgomery st., San Fran- cisco; St. Charles Hill Mng. Co., 729 Call Bldg., San Francisco	5,000	327	XIII, p. 373; M. M. R. Sierra, p. 59; XVII, pp. 477-478
Steamboat	2	18 N.	10 E.		4,500	40	XII, p. 272; XIII, p. 383; M. M. R.
Suffolk	24	21 N.	9 E.	J. G. Berryhill, owner; A. D. Post, agent, La Porte.	5,520		Sierra, p. 59
Sunshine				D. Sullivan, Downieville, et al.			M. M. R. Sierra, p. 59; XX, p. 366
Sunnyside	5, 8	21 N.	11 E.	B. L. & Annie Jones, Quincy		200	XVII, p. 477 M. M. R. Sierra, p. 138

Syndicate.....	5	21 N.	10 E.	Syndicate Hyd. Mines, Inc., 1119 Guaranty Bldg., Hollywood			See Hal Taber
Taber.....	31, 32	22	10				
Table Rock (and California Cons.).....	5	21 N.	10 E.	D. J. McDonnell & Bros., La Porte, owners. Table Rock Mng. Co., N. M. Whims, Pres., Los Angeles, lessee with option			XVII, p. 477; Pre. Rep. No. 8, pp. 22, 39
Table Rock.....							See Winkeye
Tailings.....	25, 36	21 N.	9 E.	John Rosenfeld & Son, 1024 Merchants Exchange Bldg., San Francisco			M. M. R. Sierra, p. 138
Tennessee.....				Adjoins Forest Queen			
Thistle Shaft.....	25, 36	22 N.	9 E.	W. C. Wingate, Gibsonville, Mgr.			XI, pp. 330, 419; XII, p. 265; XIII, p. 376; M. M. R. Sierra, p. 60
Thousand and One.....	24, 26	20 N.	12 E.	Thousand & One Placer Mines, Inc., lessee; Thomas Proctor, Secy., Sierra City			
Tippecanoe.....	23, 25	18 N.	9 E.	George Parent, Pike City	4,200		XIII, p. 384; M. M. R. Sierra, p. 74
Tough & Hardy.....	3	18 N.	9 E.	W. B. Meek, Camptonville			XII, p. 273; XIII, p. 384; M. M. R. Sierra, p. 138
	6	18 N.	9 E.				M. M. R. Sierra, p. 60
True Grit & Eureka Cons. Group	26, 35	19 N.	9 E.	W. B. Meek & Mrs. Hathaway, Camptonville.			
Uncle Sam (see Wisconsin-No. Fork).....	15, 16	19 N.	10 E.	John S. Binning, Alleghany; H. J. Gould, O. T. Owen, Forest. Lease & option to Wisconsin	4,600		XIII, p. 380; M. M. R. Sierra, pp. 60-61, 131-132
	21, 22	19 N.	10 E.	North Fork Gravel Mines, San Francisco			
Union Cons. Group.....				Jane Tomb	4,500		See Happy Hollow
Union Group.....	25	21 N.	9 E.	Wm. Reed, Brandy City	4,500		M. M. R. Sierra, p. 61
Union Hill.....	18	20 N.	9 E.				
Union.....							See Miner's Home
Van Slyke.....	11	20 N.	11 E.	J. W. Kerwin, Sierra City			M. M. R. Sierra, p. 61
Virginia (see Lincoln & Virginia).....	5	21 N.	10 E.	Mrs. P. L. Carmichael, Table Rock; Becker Estate, C. J. Becker, Marysville; W. H. Hartley, Table Rock			M. M. R. Sierra, p. 61
Viola Group.....				Forest City Mng. Co., Downieville.			
Wahoo & West Point.....	19	19 N.	11 E.	Frank R. Wehe, 74 New Montgomery st., San Francisco, & Arnot Estate			M. M. R. Sierra, p. 138
Wahoo Mng. Co.....				Wahoo Mng. Co., Port Wine			XX, p. 366
Washington.....	20, 21	20 N.	9 E.	C. M. Cox, Table Rock via La Porte			
Washington & National.....	4	22 N.	10 E.		5,500		M. M. R. Sierra, p. 61
	33	20 N.	9 E.	Washington Blue Gravel Mng. Co., 1107 Kohl Bldg., San Francisco. Blue Gravel Mines, Cons., lessee		243	
Watts Claim.....	14	21 N.	9 E.	See Snowden Hill	3,500		XII, p. 274; XIII, p. 384; M. M. R. Sierra, p. 62

Names and addresses of owners shown herein are those given in county tax records. The names and ownerships of many idle mines have changed but are given to facilitate reference to the old reports.



TABLE OF PLACER MINES AND PROSPECTS, SIERRA COUNTY—Continued

Name of mine	Location			Owner's name and address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Wehrle.....	Nr. Howland Flat			Frank T. Wehrle, 795 Gray st., Oroville			See Loftus Blue Lead Mines Company
Welker & Rossi Group.....	20	19 N.	9 E.	Indian Hill Mng. Co., Boston, Mass.			M. M. R. Sierra, p. 62
Westall.....				E. J. Westall Est., Sierra City			XIII, p. 378
West Point, Monte Cristo Group.....	16	20 N.	10 E.	T. E. Winrod, Downieville	5,300		M. M. R. Sierra, p. 62
White Bear.....	9, 16	20 N.	10 E.	White Bear Mng. Co., Richard Belcher, Marysville, Pres. Leased to John Costa, Downieville	5,500	566	M. M. R. Sierra, pp. 62-63
Wheche.....							See St. Charles Hill Group
Wide Awake.....	12	20 N.	10 E.	H. H. Meyers and Estate of E. L. Case, Downieville	5,645	200	XI, p. 405; XII, p. 274; XIII, p. 384; M. M. R. Sierra, p. 63
Willow.....	14	20 N.	12 E.	Bradley-Haley Co., lessee			See Pride Hydraulic
Winkeye.....	32	22 N.	10 E.	Table Rock Mng. Co., c/o C. L. Falck, Woodleaf			M. M. R. Sierra, pp. 63-64
Wisconsin-North Fork.....	15	19 N.	10 E.	Wisconsin-North Fork Gravel Mines, 103 Sanchez st., San Francisco		111	M. M. R. Sierra, p. 64
Yellow Jacket.....	9, 10	19 N.	10 E.	J. W. Evans, Graniteville; Wm. Cleary, Supt., 1928			M. M. R. Sierra, p. 64
Young America 1, 2, 3 & Live Yankee.....	28, 33	19 N.	10 E.	Diamond Peak Dev. Co., c/o Wade Armstrong, Box 801, Nevada City	5,500	240	XI, p. 401; XII, p. 275; XIII, p. 384; M. M. R. Sierra, p. 64
Yuba.....	13, 14	21 N.	12 E.	Est. of Ed Westall, Sierra City	7,000		
	23, 24	21 N.	12 E.				

Names and addresses of owners shown herein are those given in county tax records. The names and ownerships of many idle mines have changed but are given to facilitate reference to the old reports.

*White Bear Mine.* Owner, White Bear Mining Company, c/o Richard Belcher, Secretary, 230 D Street, Marysville. Leased to John Costa, Downieville. Costa has held this lease 23 years during which time he has carried on assessment work on the claims. This was an old-time producer, but the channel was lost by faulting after producing \$200,000. Though much tunneling and raising has been done since, the pay has not been recovered. A raise was completed late in 1928 which is thought to have struck the west rim. Two to five men have been employed irregularly on the claims.

*Wisconsin North Fork Gravel Mines,* D. E. Hayden, Secretary, 103 Sanchez Street, San Francisco, have under option the Wisconsin and Wisconsin Extension placer mining claims (formerly the North Fork or Uncle Sam, an early-day producer) and hold the following adjoining properties: Panama Placer, Homestead Group of six patented quartz claims, and Entry and Entry Extension quartz claims.

On the Wisconsin claims they have enlarged and repaired about 1500 feet of old tunnel and report having driven a total of 500 feet of drifts and raises, but without picking up the pay streak. They have plans for a new drainage adit which they think should tap the channel about 600 feet south of the present working tunnel. Recently only assessment work has been done here.

From the adit on the Panama Placer, a raise was put up in 1928 but was in the rim. Further work is planned for 1929, to advance the adit across the bottom of channel.

On the Homestake claims a small vein reported to prospect well in gold, was found in the contact of slate and serpentine. The outcrop was faulted and crushed on the west and cut by the Panama channel on the east and may be prospected through the Panama workings. The Homestake was a producer many years ago.

The Entry claims are being prospected through an adit.

The various claims have not been producers since this company began work. Assessment No. 84 was levied in June, 1928.

#### IRON ORE

Magnetite occurs in northern Sierra County in the vicinity of Spencer Lakes and Lake Hawley. The chain of deposits, most of them indicated by small outcrops, are of the regional metamorphic type in schist derived from diorite and accompanied by marble and limestone. Baron Richthofen, and later James D. Hague and Clarence King, described the deposits over 55 years ago and great hopes were held for the development of an iron-mining industry there, but nothing resulted.

*Sierra Iron Company,* San Francisco, owns patented mining claims covering a length of 9900 feet and a width of one-fourth mile including most of the magnetite outcrops mentioned, in Secs. 11, 14 and 23, T. 21 N., R. 11 E., at an elevation of 6700 feet. Johnsville, Plumas County, the nearest town, is  $5\frac{1}{2}$  miles north in an airline and Blairsden, on the Western Pacific Railway, is 12 miles distant. Several miles of road would be required.

Hague and King estimated the aggregate amount of ore in sight as not less than 350,000 tons. Some of the smaller bodies of ore are fine-grained and high grade and contain up to 70% iron, but there is only about 5000 tons of such ore, according to C. Erb Wuensch, who made

a report several years ago. The largest outcrop, lying 1000 feet south-east of Lake Hawley, is 200 feet long by 150 feet wide and if it extends to a depth of 75 feet would contain about 320,000 tons according to Wuensch's estimate. This he said averages 37% iron and 43% insoluble of which 26% is silica. Other small lenses nearby contain about 10,000 tons of similar grade.

There is an old hydroelectric power plant belonging to the Four Hills mine about  $2\frac{1}{2}$  miles from the main iron ore outcrop, and this might be utilized.

#### LIMESTONE AND MARBLE

Dolomitic limestone and marble occur abundantly in the Calaveras formation (Carboniferous) in Sierra County. These deposits are found as a series of disconnected lenses running west of north from the Nevada County line past Sierra City near the eastern border of the Calaveras rocks and into Plumas County. The largest body of the limestone so far mapped is about midway between Downieville and Sierra City, extending for nearly two miles northwest from the main road, and having a maximum width of nearly one-half mile. The magnesia contents of samples from some of these deposits was 10% and  $19\frac{1}{2}\%$  according to analysis by the U. S. Geological Survey.

The most accessible bodies of the limestone are:

(1) Three miles northeast and east of Downieville in Sec. 19, T. 20 N., R. 10 E., and extending southeast into Secs. 19, 30 and 32, T. 20 N., R. 11 E.

(2) The large deposit mentioned above, is in  $W\frac{1}{2}$  Sec. 27, T. 20 N., R. 11 E.

(3) Smaller lenses north and northeast of Loganville in Secs. 29, 30 and 32, T. 20 N., R. 12 E.

Lime from the first and last mentioned localities has been burned and used locally in past years, but there is no present operation.

#### SOAPSTONE

Blocks of soapstone were quarried 40 years ago at the Alaska Mine near Pike City and were used at the mine for hoist foundations and around the furnaces.

#### STONE INDUSTRY

The stone industry of the county is confined to the utilization of sand, gravel and rock for highway construction. There are no commercial producers of these in the county.

#### TUNGSTEN

In June, 1927, H. S. Tibbey, Downieville, sent to the laboratory of the Division of Mines and Mining a sample which contained scheelite and ferberite. The exact locality where this was found was not stated.

#### REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

Mr. Chas. V. Averill, district Mining Engineer, Redding Field Division, has been temporarily assigned to field work in Napa, Lake and Mendocino counties of the San Francisco Field Division.



## SAN FRANCISCO FIELD DIVISION

### NAPA COUNTY

By CHAS. VOLNEY AVERILL, Mining Engineer

#### Geography.

Napa County is located just to the north of San Pablo Bay, which is a northerly extension of San Francisco Bay. The boundaries between Napa County and Lake County on the north, Sonoma on the west and Solano on the east are marked by the crests of ridges of the Coast Range Mountains. The area of the county is 783 square miles. Napa, the county seat and the largest town, is about 40 miles north of the large metropolitan area around San Francisco Bay. It is an up-to-date little city with paved streets, municipal water supply, power service by two companies, and other modern improvements. The population of the town is about 7500 persons.

#### Topography.

The important feature of the topography is the fertile Napa Valley, 40 miles long and three or four miles wide. The balance of the county is in the foothills and low mountains of the Coast Range, with several small valleys lying among the hills. Drainage of the larger part of the area is by way of the Napa river, which flows through Napa Valley.

#### Climate.

The equable climate of Napa County is very favorable to agriculture and other industry. The annual mean temperature is 58° F.; and there is an average of 250 cloudless days per year. Rainfall averages 24 inches annually. Snow occasionally falls on the higher mountains, but usually melts within a few hours.

#### Transportation.

The electric line of the San Francisco, Napa and Calistoga Railroad connects with the boats of the Golden Gate Steamship Company at Vallejo, thus giving a direct route to San Francisco. This line runs the full length of Napa Valley; and loading stations are maintained every few miles. The Southern Pacific has a parallel line running the length of Napa Valley with terminus at Calistoga. Branches of this road cross the southern portion of the county in an easterly and westerly direction also, giving a connection with the main line to Oakland and Sacramento. The Napa River is navigable as far as Napa, and affords a route for transportation by water into San Francisco Bay. The State highways in this county are excellent. From Napa, paved highways run east, west, north and south. The Carquinez highway bridge, completed in 1928, is a link in the highway system from this section to the cities on the east side of San Francisco Bay, that does away with the need of making any part of the trip on a ferry boat.

#### Industries.

Agriculture is, by far, the most important industry of Napa County. 15,000 acres are devoted to raising grapes, 12,000 to prunes, 4000 to pears, and cherries, nuts, apricots, figs, peaches, plums, apples, olives lemons and oranges are raised. 75,000 acres are used for growing alfalfa, barley, corn, hay, oats, potatoes, wheat and vegetables. The hills and the slopes of the mountains afford pasturage for stock.

## MINERAL PRODUCTION OF

Year	Quicksilver		Mineral water	
	Flasks	Value	Gallons	Value
Manhattan Mine output, 1863 to 1876.....	3,594	\$235,876	1	
1862.....	444	16,139		
1863.....	852	35,852		
1864.....	2,714	124,573		
1865.....	3,545	162,716		
1866.....	2,254	119,755		
1867.....	7,862	360,866		
1868.....	9,808	450,187		
1869.....	6,598	302,848		
1870.....	5,766	330,853		
1871.....	4,098	258,584		
1872.....	4,876	321,475		
1873.....	5,266	423,018		
1874.....	11,705	1,231,132		
1875.....	9,453	795,470		
1876.....	11,303	497,332		
1877.....	13,127	489,637		
1878.....	10,810	355,649		
1879.....	9,446	281,961		
1880.....	6,830	211,730		
1881.....	7,746	231,063		
1882.....	9,013	254,467		
1883.....	7,784	223,790		
1884.....	5,188	158,234		
1885.....	3,891	119,648		
1886.....	5,656	200,788		
1887.....	6,247	264,717		
1888.....	5,150	218,875		
1889.....	5,402	243,090		
1890.....	3,934	206,535		
1891.....	4,896	221,544		
1892.....	8,612	350,595		
1893.....	11,505	422,809		
1894.....	9,705	298,016	97,275	\$41,231
1895.....	9,318	372,500	199,397	99,700
1896.....	11,411	403,031	218,680	81,335
1897.....	12,281	459,753	159,896	81,948
1898.....	12,368	472,972	169,261	63,919
1899.....	11,696	598,322	171,567	85,964
1900.....	8,724	403,500	171,000	72,200
1901.....	7,798	388,176	158,830	109,900
1902.....	7,142	304,474	236,229	97,048
1903.....	7,859	333,006	244,400	124,000
1904.....	15,328	199,586	386,000	104,750
1905.....	4,853	171,910	279,400	89,500
1906.....	2,380	86,870	84,000	90,500
1907.....	2,500	95,400	240,000	103,600
1908.....	2,340	98,912	145,500	101,000
1909.....	1,625	80,535	123,072	96,279
1910.....	646	29,231	152,772	92,960
1911.....	140	6,441	141,540	86,530
1912.....	287	12,065	136,750	81,997
1913.....	287	11,546	151,520	75,548
1914.....	240	11,772	142,940	73,280
1915.....	507	45,224	133,387	73,535
1916.....	1,150	107,525	152,764	93,370
1917.....	834	78,320	126,124	70,058
1918.....	1,297	143,850	92,512	59,620
1919.....	644	58,140	76,860	60,395
1920.....	266	18,588	80,431	38,621
1921.....	35	1,659	72,364	55,760
1922.....	189	5,143	80,481	54,341
1923.....	157	9,759	69,639	55,757
1924.....			73,608	53,391
1925.....			63,836	44,251
1926.....			80,376	49,468
1927.....	776	88,425	81,864	50,116
Totals.....	340,158	\$15,515,457	4,994,275	\$2,611,962

<sup>1</sup>Includes crushed rock, macadam, rubble, paving blocks, sand, gravel.

<sup>2</sup>Napa Soda Springs have been bottling water for sale since 1860; but no segregated figures available for Napa County previous to 1894.

<sup>3</sup>Flasks of 76½ pounds to June, 1904; of 75 pounds since.

<sup>4</sup>See under 'Unapportioned.'

[illegible]



Manufacturing is an important industry in the town of Napa. The products are shoes, shirts, gloves, patent leather, paper boxes and dairy products. The good transportation, municipal water supply, power supply and fine climate are great advantages to these plants.

#### Mineral Resources.

Quicksilver, associated with the serpentine of the Coast Range, is the important mineral product of Napa County at the present time. This serpentine belt also contains deposits of chromite and magnesite. The magnesite deposits have been worked in the past, but they are not active at present. Asbestos has received some attention, but no commercial deposits have been developed. Portland cement was once an important product of Napa County, but none has been produced for several years. Crushed stone was formerly produced on a small scale at many quarries in the county. This business has now been concentrated in a single large plant a short distance from Napa, where transportation by both rail and water is very convenient. Bodies of volcanic rocks lie in the northern and western portion of the county, and deposits of silver have been found associated with them. One of these silver mines, the Palisade, is active at present. The well-known mineral springs of the county continue to attract many visitors but the tendency is to operate these more as pleasure resorts, than as health resorts.

The minerals of present commercial importance are associated with the serpentine found with the Jurassic sediments that lie in a narrow belt on each side of the recent sediments of the Napa Valley and in a broader belt across the northern part of the county. Tertiary sediments cover a small area of the Jurassic to the northeast of Napa Valley and a band of volcanic rocks is found along the western border of the county. Cretaceous sediments occupy the eastern portion and extend well beyond the eastern boundary.<sup>1</sup> The total recorded mineral output of the county is shown on the tabulation herewith.

#### ASBESTOS

*Napa Asbestos Quarries.* Report XVIII of the State Mineralogist, 1922, tells of the work by Jas. S. Brogan of San Francisco and R. R. Norton of Berkeley on a deposit of chrysotile asbestos in Sec. 4, T. 7 N., R. 3 W. These men had located 19 claims, and had driven a tunnel for a distance of 60 feet. More work was done later on this deposit, but no material of commercial importance was found, and the property has been idle for several years.

Bibl: State Mineralogist's Report XVIII, p. 419.

#### CHROMITE

*Graves Ranch Mine*, located eight miles northwest of Monticello, is reported to have produced about 900 tons in 1918.

*Astute Chrome Mine*, located in Sec. 32, T. 10 N., R. 5 W., developed a lens of ore in serpentine and shipped 200 tons in 1920.

Both of the above mentioned mines were shipping to the Sawyer Tanning Company at Napa. No chrome mines are active in Napa County at the present time.

Bibl: State Mineralogist's Report XVII, p. 158.

<sup>1</sup> Geological Map of the State of California, State Mining Bureau, 1916.

## CLAY

A bed of clay 60 ft. or more thick is found on the east side of Napa Valley, about a mile east of Napa, and it extends for a distance of several miles along the valley. Brick and Portland cement have been made in former years from the clays found in the vicinity of Napa.

*Teale Kaolin Deposit (Clark and Marsh Kaolin Mine).* There is a very interesting deposit of residual kaolin, formed from the alteration of a rhyolitic rock, in Secs. 12, 13, 18, T. 8 N., R. 6 W., owned by W. R. Teale of Calistoga. This has been described at some length by Dietrich<sup>1</sup> in a recent bulletin issued by this division. Parts of the deposit are white, but other parts are stained by iron, and Dietrich states that hand sorting is necessary, rather than selective mining, if the material is to be mined on a commercial scale. A better grade of material might be developed by further prospecting. The clay has been tested on several occasions by manufacturers of clay products; and Dietrich gives the results of several special tests made on it for color after firing, strength, shrinkage and temperature of fusion.

J. R. Clark of Calistoga states that he is negotiating at the present time for further prospecting of the deposit, and that if found satisfactory a washing plant will be installed to turn out 900 tons of washed clay per month. A plant of this kind is necessary in order to insure the uniform properties demanded by the manufacturers as to color and shrinkage.

Bibl: State Mineralogist's Report XIV, p. 262; Prel. Report No. 7, p. 65; State Division of Mines and Mining Bull. 99, p. 132.

## COAL

An occurrence of coal in Pope Valley, found in digging a well, is mentioned in Report XIV of the State Mineralogist, page 269.

## COPPER

Occurrences of copper are mentioned in Report XIV of the State Mineralogist in the following locations: five miles north of Calistoga on Mount St. Helena, in Sec. 17, T. 10 N., R. 5 W.; four miles west of Yountville, in Sec. 5, T. 6 N., R. 5 W.; near Monticello, and from the Juniper group and the White Rock group, Manhattan (Knoxville).

Bibl: Cal. State Min. Bur. Bull. 50, p. 165; State Mineralogist's Report XIV, p. 269.

## GOLD AND SILVER

See under Silver.

## INFUSORIAL EARTH

Report XIV of the State Mineralogist lists two undeveloped deposits of infusorial earth, one on the ranch of Mrs. Kettlewell in Friends Valley west of Calistoga, the other four miles southeast of St. Helena. Nothing is being done with these deposits at present.

<sup>1</sup> Dietrich, W. F., The Clay Resources and Ceramic Industry of California, State Division of Mines and Mining, Bull. 99, 1928.

## IRON

Undeveloped deposits of iron ore have been noted at the head of Sulphur Creek, also west of St. Helena, and in Conn Valley.

Bibl: State Mineralogist's Report II, p. 200; IV, pp. 229, 242, 258; XII, p. 327; XIII, p. 504; XIV, p. 271; State Mining Bureau Bull. 38, p. 365.

## LIME AND LIMESTONE

Lime kilns were formerly operated in Pope Valley, and limestone was produced for the manufacture of Portland cement. Neither of these industries is active in Napa County at the present time.

Bibl: State Mineralogist's Report XIII, p. 629; XIV, pp. 262, 271.

## MAGNESITE

During the late war and just afterward, important quantities of magnesite were produced in Napa County, the greatest yearly production being that of 1917, a little over 40,000 tons. Since 1924 there has been no production, and with the exception of the Priest mine, the magnesite properties were not visited by the writer.

The production of magnesite is an important industry in other parts of the state, and a special bulletin<sup>1</sup> on it was published by the State Mining Bureau in 1925. Magnesium is the lightest metal known, and it is receiving some attention at the present time for the construction of aircraft and other machines in which it is important to keep the weight as low as possible. Alloys of satisfactory strength and of a weight less than that of aluminum can be made of magnesium; and the metal will, in all probability, increase in industrial importance in the near future. Most of the magnesite produced in this state at present is used in the manufacture of plastic cements for flooring, sanitary kitchen and hospital finishing, etc.

*Maltby No. 2 Mine.* Owner, *Crown-Willamette Paper Company*, 248 Battery Street, San Francisco. Location, Sec. 28, T. 8 N., R. 4 W. C. S. Maltby of San Francisco leased this mine in February, 1923, and calcined the magnesite at the rate of 15 tons of the calcinated material per 24 hours, in a rotary kiln that had formerly been used in the reduction of quicksilver. The lease covered the old Blanco and the Snowflake mines, formerly owned by the Tulare Mining Company, the first-named having been operated by that company in 1917 and 1918. The product was dead-burned and sold as a refractory material during the last operations by C. S. Maltby.

Bibl: State Mineralogist's Report XII, p. 328; XIII, p. 505; XIV, p. 275; XX, pp. 26, 27; State Mining Bureau Bull. 79, p. 54; Bull. 38, p. 329. U. S. Geol. Surv. Bull. 355, pp. 29, 31; Min. Res. 1891, p. 584.

*Priest Mine.* Owner, D. C. Priest, St. Helena. Location, Sec. 23, T. 8 N., R. 4 W., about 18 miles east of St. Helena by road. Harold U. Smith of St. Helena holds a lease on this mine, from which he produced magnesite of a refractory grade during the late war. He states

<sup>1</sup>Bradley, W. W., Magnesite in California: State Min. Bur. Bull. 79.



that the ore contains from 3% to 6% iron. A pile of ore containing perhaps 100 tons is on the property at the portal of his main tunnel at the present time. This tunnel is caved. Several veins of magnesite from 2 to 4 feet wide were observed in open cuts and short tunnels on this property. These could easily be followed for a short distance by means of winzes to prospect them for continuation at depth, and if this work developed orebodies of attractive size, tunnels could be driven from the slope of the hill below to tap them at a depth of several hundred feet. The country-rock is serpentine.

Bibl: State Mineralogist's Report XIV, p. 275; State Mining Bureau Bull. 38, p. 328; Bull. 79, p. 55. U. S. Geol. Surv. Bull. 355, p. 31.

*Snowflake Mine.* See Maltby No. 2 Mine.

*Tulare Mining Company.* See Maltby No. 2 Mine.

*White Rock Mine* (formerly known as *Pope Valley*, also *Walters Mine*). Owner, Mary J. Walters, Pope Valley. Location, Sec. 2, T. 9 N., R. 5 W., 22 miles by road northeast of Rutherford. This mine has been one of the most important producers in the state. The white outcrops and dumps, located on an open hillside 400 feet above the level of Pope Creek, are striking features that can be seen for a distance of many miles. The first production was made in 1894. Production on a larger scale started in 1916; and in 1922, the production was about 100 tons daily. The ruins of the ten-ton stack kilns used for calcinating may be seen near the highway. The orebodies are said to have been bottomed at a depth of 300 feet below the outcrop.

Bibl: State Mineralogist's Reports XIV, p. 274; XX, p. 27; State Mining Bureau Bull. 38, p. 330; Bull. 79, pp. 56, 58. U. S. Geol. Surv. Bull. 355, p. 28.

#### MANGANESE

Bulletin No. 76 of the Division on 'Manganese and Chromium' lists the following manganese prospects in Napa County. Harold U. Smith of St. Helena states that 35 or 40 cars of manganese ore were shipped from Napa County during the late war.

*Bacon and Kenney Prospect* is five miles west of Oakville by road, in Sec. 19, T. 7 N., R. 5 W. The deposit was small and of low grade.

Bibl: State Mineralogist's Report XIV, p. 276.

*Cavagnaro Prospect* lies in Sec. 3, T. 9 N., R. 6 W., one-half mile west of the Aetna Quicksilver Mine.

*Moore Creek Manganese Deposit* (Manganese Ridge Prospect) lies on the ridge of the same name, which runs east and west, and is a spur of the main ridge separating Conn Valley and Moore Creek. The property is in Sec. 15, T. 8 N., R. 5 W., six miles northeast of St. Helena. Samples of high-grade manganese oxide have come from this property.

## MINERAL PAINT

*Carl Brown Paint Mine*, on Benali Mountain, two miles south of Calistoga is owned by W. R. Teale. This is a white material that has at times been used in the manufacture of porcelain. None has been shipped recently. Mr. Teale also owns a deposit of red material about five miles south of Calistoga.

*Nettie Brown Ranch*. A deposit of yellow ochre, from which several carloads were shipped years ago, is located on this property. It is one and a half miles east of Calistoga, and is owned by A. M. Goodrich.

Bibl: State Mineralogist's Report XVII, p. 159; State Mining Bureau Bull. 38, p. 339.



Dr. Aalder's Sanitarium at Calistoga.

## MINERAL WATER

*Aetna Springs*. Owner, Len D. Owens Company of Aetna Springs P. O. Location, Sec. 1, T. 9 N., R. 6 W. Several mineral springs of different temperatures, containing dissolved minerals, which vary in kind and quantity, occur on this property. Formerly the place was equipped as a health resort, and facilities were provided for bathing in the mineral waters. All of this equipment has been removed and different equipment added, so that the place is now operated purely as a pleasure resort, and the mineral waters are no longer utilized.

For Bibliography, see State Mineralogist's Report XIV, p. 277.

*Aalder's Sanitarium*. Small cottages capable of accommodating 75 persons have been built around a large bath house in the town of Calistoga. The baths will accommodate 125 persons. They are supplied with hot mineral water from a drilled well, and the water is circulated through radiators in the cottages. Dr. Aalder expects shortly to install a concrete swimming tank 150 feet long. Wells to supply water for this have been drilled.

*Calistoga Hot Springs* is located in the town of Calistoga. G. J. Pacheteau is the proprietor. Three wells that have been drilled to a depth of 135 feet have been capped to supply hot water for the bath house and swimming tank. If the valve in the top of the well casing is opened, a jet of steam and hot water spouts to a height of about 75 feet. The bath house accomodates 75 to 100 persons per day; and



Wells ('Geysers') spouting hot water at Calistoga Hot Springs.

the swimming tank is about 150 long by 50 feet wide. Camping grounds, housekeeping cottages and a golf course are available. The water from the spouting wells smells strongly of hydrogen sulphide.

Bibl: State Mineralogist's Report I, p. 8; VI, Pt. I, p. 67; VIII, p. 416; X, pp. 349, 355; XII, p. 341; XIII, p. 514; XIV, p. 277. U. S. Geol. Surv. Bull. 32, pp. 204, 210; Mon. XIII, p. 403;



Water Sup. Pap. 338, p. 108. Geol. Surv. of Cal., Geol. Vol I, p. 87. W. Anderson, 'Mineral Springs and Health Resorts of California,' pp. 114, 116, 1890.

*Congress Springs*,  $3\frac{1}{2}$  miles southwest of Napa, is not being developed.

Bibl: U. S. Geol. Surv. Wat. Sup. Pap. 338, p. 156.

*Elms Hot Springs* is in Calistoga. Hot sulphur water of a temperature of  $169^{\circ}$  flows from a well 202 feet deep. A resort was formerly operated here, but it is not active at present.

Bibl: State Mineralogist's Report XVII, p. 160.

*Hotel Calistoga* is in the center of the town of Calistoga. Owen Kenny is owner and B. F. Hughes is manager. Hot water from a drilled well is used for bathing in the hotel and to supply a concrete swimming tank. The water has a slight odor of hydrogen sulphide.

*Lathrop Hot Sulphur and Mud Spring*, one mile south of Calistoga is similar to the Calistoga Hot Springs.

*Lithia Spring*. A. Banchieri bottles a natural lithia water at his spring near Calistoga.

*Musante Spring*. This is a flowing well, 180 feet deep, owned by G. Musante and located in the town of Calistoga. The water issues at a temperature of  $212^{\circ}$  F. It is cooled, carbonated and bottled at the rate of over 3000 gallons per year. The following analysis is by Frank T. Green of San Francisco.

*Grains per U. S. Gallon.*

Calcium Sulphate	1.21	Fixed Solids	37.60
Magnesium Sulphate	0.30	Silica	8.35
Sodium Sulphate	5.28	Soda, combined	2.27
Iron and Alumina	0.17	Total solids	39.87
Sodium Chloride	19.99	Ignition loss	2.27

*Myrtledale Hot Springs*, R. Roy Leveira, proprietor, is located one and a half miles northwest of Calistoga. It is equipped with a hotel, stone bath house, open air mineral swimming bath and other facilities for amusement. The mineral water comes from drilled wells at a temperature of  $212^{\circ}$  F. Steam, mud and shower baths are available in the bath house, and hot sulphur water is piped to all bathrooms in the hotel. Following are analyses of waters used for drinking purposes:

*Grains per U. S. Gallon.*

Calcium Carbonate	4.77	Potassium Carbonate	4.76
Sodium Carbonate	9.53	Magnesium Carbonate	Traces
Silicon Dioxide	6.58	Organic matter	None
Lithium Carbonate	Traces		
Sodium Chloride	1.04	Total solids	26.68
Water of crystallization	3.5	Magnesium Carbonate	2.2
Silica	19.1	Hydrogen Sulphide	Trace
Borax	Trace	Potassium Chloride	Trace
Potassium Carbonate	Trace	Organic matter	Negative
Sodium Carbonate	Trace		
Sodium Chloride	16.8	Total residue	44.7

Bibl: State Mineralogist's Reports XIV, p. 278; XVII, p. 160.

*Napa Soda Springs*. Owner, Chas. H. Jackson of Napa Soda Springs P. O. Location, Sec. 2, T. 6 N., R. 4 W., seven miles north of Napa.



Myrtledale Hot Springs.



Napa Soda Springs.

This is one of the best-known springs of California, both as a resort, and for its bottled waters. The water has been on the market since 1860; and a large bottling works is still operated. The resort has accommodations for 325 persons, and is equipped with swimming pool, ballroom and large grounds with ferns, palms, trees and flowers. An analysis of the water follows:

*Grains per U. S. Gallon.*

Sodium Bicarbonate -----	13.12	Sodium Chloride -----	5.20
Calcium Carbonate -----	10.83	Sodium Sulphate -----	1.84
Iron Subcarbonate -----	7.84	Alumina -----	.60
Silica -----	.62		
Magnesium Carbonate -----	26.12	Total residue -----	68.76

Bibl: State Mineralogist's Reports VI, Pt. I, p. 69; VIII, p. 416; X, p. 362; XII, p. 341; XIII, p. 514; XIV, p. 279. U. S. Geol. Survey Bull. 32, pp. 207, 211; Water Sup. Pap. 338, p. 155. Anderson, W., 'Mineral Springs and Health Resorts of California,' pp. 201-207.

*Napa Vichy Spring.* Water from this spring is bottled by John Lepori of Napa. It is located in Napa Valley four miles northeast of Napa.

Bibl: State Mineralogist's Report XIV, p. 280. U. S. Geol. Survey Water Sup. Pap. 338, p. 255.

*Original White Sulphur Springs*, located in Secs. 3 and 4, T. 7 N., R. 6 W., two miles south of west from St. Helena, are owned by the estate of Wm. J. Mercier.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 69; VIII, p. 417; XII, p. 341; XIII, p. 514; XIV, p. 281. U. S. Geol. Survey Bull. 32, p. 209; Water Sup. Pap. 338, p. 254; Geol. Surv. of Cal., Geol. Vol. I, p. 87. Anderson, W. (op. cit.), pp. 263, 264.

*Pope Mineral Spring*, located in Sec. 29, T. 9 N., R. 4 W., 21 miles northeast from Rutherford, and a mile west of Samuels Soda Springs, is owned by Peter Guillaume of Yountville.

Bibl: State Mineralogist's Report XIV, p. 281. U. S. Geol. Survey Water Sup. Pap. 338, p. 162.

*Priest's Soda Spring*, located in Sec. 23, T. 8 N., R. 4 W., 16 miles east of St. Helena, is owned by D. C. Priest of Chiles.

Bibl: State Mineralogist's Report XIV, p. 281. U. S. Geol. Survey Water Sup. Paper 338, p. 161.

*Samuels Soda Springs*, located in Sec. 28, T. 9 N., R. 4 W., on Trout Creek, a branch of Pope Creek, are at an elevation of 775 feet (bar.). They are 10 miles northwest of Monticello, 24 miles northeast of Rutherford, or 30 miles northwest of Winters. Robert J. Little of Monticello is the proprietor. Water from these springs has been bottled and sold for more than fifty years; and a resort is operated also. Several different springs give water of different temperatures and mineral content. An analysis of water from the 'Soda Spring' follows. This is from a printed statement furnished by the proprietor; and the units of measurement are not stated, but probably are grains per U. S. gallon.



*Grains per U. S. Gallon.*

Silica -----	4.78	Potassium Sulphate -----	2.99
Sodium Chloride -----	21.35	Sodium Bicarbonate -----	15.95
Calcium Carbonate -----	1.25	Calcium Sulphate -----	.25
Calcium Phosphate -----	.58	Magnesium Carbonate -----	37.78
Iron Carbonate -----	.95		

Lithium—well marked test with spectroscope.

Strontium—slight test with spectroscope.

Boric acid—marked test.

Organic matter—traces.

Free carbon dioxide gas, cubic inches per gallon, 278.16.

Bibl: State Mineralogist's Reports XII, p. 341; XIII, p. 514; XIV, p. 282. U. S. Geol. Survey Wat. Sup. Paper 338, p. 159.

*Sequoia Resort*, located on the Hudeman Rancho, eight miles northwest of Napa, is the property of Theo. Gier, 270 Grand Ave., Oakland. There are two springs, one of which contains salts of sodium, magnesium and calcium.

Bibl: State Mineralogist's Report XIV, p. 282.

*St. Helena Bottling and Cold Storage Company* (see Walters Springs).

*Walters Springs*, located in Sec. 12, T. 9 N., R. 5 W., 16 miles northeast of St. Helena, are the property of H. L. Connor of Pope Valley. Hotel accommodations are provided; and water is bottled at the springs by the St. Helena Bottling and Cold Storage Company. An analysis of the water follows.

*Grains per U. S. Gallon.*

Silica -----	6.66	Potassium Bicarbonate -----	.37
Sodium Chloride -----	25.29	Sodium Bicarbonate -----	24.85
Calcium Carbonate -----	7.01	Calcium Phosphate -----	.26
Barium Carbonate -----	47.17	Magnesium Carbonate -----	47.17
Iron Carbonate -----	.66	Manganese Carbonate -----	.01

Lithia—well marked test with spectroscope.

Strontium—well marked test with spectroscope.

Boric acid—well marked test with spectroscope.

Free carbon dioxide, cubic inches per gallon, 343.0.

Bibl: State Mineralogist's Report XIV, p. 282. U. S. Geol. Survey Water Sup. Paper 338, p. 159.

## ONYX MARBLE

There are specimens of onyx marble in the museum of the State Mining Bureau, from a locality formerly called 'Zem Zem,' near Knoxville. Calcareous springs occur nearby.

Bibl: Cal. State Min. Bur. Bull. 37, p. 111; Bull. 38, p. 369. Anderson, W. (op. cit.), p. 269. U. S. Geol. Survey Wat. Sup. Paper 338, p. 268.

## PETROLEUM

*Griffiths Oil Company*. The early operations by this company and the geology of the Berryessa Valley have been described at some length by Laizure.<sup>1</sup> Briefly, strong seepages of oil were found in steeply-dipping beds of the Knoxville formation. The Griffiths Company drilled four shallow wells in these steeply-dipping beds, one of which is said to be capable of producing a half barrel per day of a high-gravity

<sup>1</sup> Laizure, C. McK., Oil Possibilities in Berryessa Valley, State Mineralogist's Report XVIII, p. 608.

oil with paraffin base. This oil is reported to contain ichthyol, a substance that brings a high price for the preparation of certain antiseptic ointments. These prospect wells are located in Sec. 29, T. 8 N., R. 3 W. A study of the geology indicated that folds in the beds and flatter angles of dip were located in the vicinity of Section 7. Accordingly, well No. 5 was drilled in this location to a depth of 2758 feet. Serious trouble was had with tools and casing in drilling this well; and well No. 6 was later started. This well has reached a depth of 2743 feet, in the Spanish grant near Sec. 7, T. 8 N., R. 3 W. W. B. Griffiths of Napa states that for the last 1200 feet this well has shown gas, and that the last 200 feet has shown oil. The bottom of the hole is in Cretaceous limestone. Griffiths is now endeavoring to finance the project, so that the water can be shut off and the hole continued. He states that there is complete equipment of a value of \$100,000 at the well, that can be started up at a moment's notice.



Walters Springs.

*Associated Oil Company* has done some prospecting in the vicinity of the Griffiths project. This company is said to have recently acquired large holdings from the Berryessa Cattle Company in the vicinity of Sec. 27, T. 9 N., R. 4 W.

*Northern California Petroleum Company*, A. T. Taecker of Napa in charge, is drilling a well in T. 4 N., R. 5 W.

#### QUICKSILVER

The greatest activity, by far, in development and mining in the northern Coast Range Mountains is in the realm of quicksilver. The high price, ranging from \$115 to \$135 per flask, has stimulated prospecting and the production of the liquid metal. This high price is the result of agreements between the Spanish and Italian producers, made through their governments. Uses of quicksilver are increasing in the



manufacture of fulminates for blasting, antiseptic drugs, radio goods, neon electric signs, and the recording thermometers and other instruments that are coming into such wide use in large industrial plants of all kinds, and in aircraft. This tends to keep the price of the metal high; but there is more than the usual amount of uncertainty in how long it will stay at the present level, because of the artificial control of the price by European producers, who have much better grades of ore than are available in this country. A help in this regard is the protective import duty of 25¢ per pound on quicksilver brought into the United States. Less than half of the requirements of this country is produced here; while Spain and Italy turn out about 90% of the total world production. The output of mines in this country has been rising rapidly during the past year.

Metallurgists who have installed the new plants for the reduction of quicksilver ores seem to agree that the rotary furnace, similar to a cement kiln, with an oil fire within, is the most practical apparatus for getting the metal out of the ore. A mixture of dust, products of combustion and vapors is discharged from such a furnace; and the apparatus that follows varies at the different plants. The dust is precipitated while the vapors are still above the temperature of condensation of the quicksilver; Cottrell precipitators, cyclone precipitators similar to those used to remove shavings and sawdust from sawmills, or plain brick chambers of large cross-section are in use for this purpose. Condensers consist of sewer-tile or metal pipes, either vertical or inclined, followed by large chambers consisting of wood-stave tanks, in which the velocity of the stream of vapor is reduced to precipitate the last of the condensed metal. Water is sprayed into the condensers to reduce the temperature. The tendency is to substitute metal for nonconducting sewer tile in condensing systems, but corrosion of the metal is severe. Iron coated with acid-resisting paint, and monel metal are in use. Research to find a metal or alloy capable of resisting the corrosive acids formed in the condensing system would seem to be indicated; and a great gain could also be made by keeping the vapors dry until after the quicksilver is condensed. That is, if the cooling medium could be kept outside of the condensers while the temperature is between the condensing temperature of quicksilver and that of water, the formation of corrosive acid would be avoided to a large extent. Many things of value in this problem of condensation, also in the matter of controlling the temperatures of the process, could probably be learned from a study of how similar problems are met in the oil refineries, particularly in the new cracking processes.

*Acme Mines and Mill, Inc.* See La Joya Mine and Oat Hill Mine.

*Aetna Quicksilver Mine Consolidated*, Chas. A. Gray, president, 1535 Russ Building, San Francisco; Henry J. Bartlett, secretary. Location, Secs. 2 and 3, T. 9 N., R. 6 W., nine miles northeast of Calistoga. The best way to reach the mine is from St. Helena, the road being 22 miles long.

Bradley<sup>1</sup> has given a description of the early operations of this mine, which was formerly a large producer. The most important producing periods were from 1877 to 1887, and from 1892 to 1898. The last period

<sup>1</sup>Bradley, W. W., Quicksilver resources of California: Cal. State Min. Bur. Bul. 78, p. 77, 1918.



of production, by the *Napa Properties Consolidated*, Harry Thompson of Redding in charge, ended in November, 1927. At the time of visit (January, 1929), the only operation was that of cleaning up small quantities of free quicksilver from below the reduction plant and dumps by Dave Llewellyn of Aetna Springs. Since that time the property has been leased to R. L. Cavanagh of Aetna Springs, who intends to develop at a point on the Red Hill claim, where there is a good showing of cinnabar on a contact between sandstone and basalt. Holdings of the company total about 900 acres.

The Scott furnace described by Bradley<sup>1</sup> has been dismantled; and the brickwork has been treated to recover absorbed quicksilver. The present plant was built by the *Napa Properties Consolidated* in 1926. It consists of an oil-fired Gould rotary furnace 4 ft. by 65 ft. and rock crusher with bucket elevator to ore bins, power being furnished by a 25-h.p. Fairbanks-Morse Y type oil engine. The dust chambers and the sewer-tile condensing system of this plant are in poor repair, and will probably have to be rebuilt before the plant can be operated. A gasoline drag-line shovel, with a bucket of 1000 pounds capacity, is on the property.

Bibl: State Mineralogist's Reports V, p. 96; XI, p. 72; XII, p. 362; XIII, p. 597; XIV, pp. 284-286; Chap. rep. bien. period 1913-1914, pp. 111-114; Bull. 27, pp. 72-76; Bull. 78, pp. 77-80. U. S. Geol. Survey Mon. XIII, pp. 354, 371-374; Min. Res. 1884, p. 492; 1892, p. 148; 1902, p. 252; 1909, Pt. I, p. 553; 1910, Pt. I, p. 698; 1911, Pt. I, p. 901; 1912, Pt. I, p. 942; 1913, Pt. I, p. 205; 1914, Pt. I, p. 326; 1915, Pt. I, p. 269. Min. Res. W. of Rocky Mts., 1872, p. 523; 1873, p. 11; 1874, p. 30; 1876, p. 20. Geol. Survey of Cal., Geol. Vol. I, p. 91. Eng. & Min. Jour., Nov. 1, 1913, p. 828.

*Bella Oaks Mines Company (Bella Union)*. Owner, *Bella Union Quicksilver Co.*, Arthur H. Reddington of San Francisco, agent for trustees. The *Bella Oaks Mines Co.* is operating the property under a lease and option. John Steckter of Napa is president, S. H. Wyckoff of Napa is secretary, and E. D. Perrin is in charge at the mine. Property consists of 64 acres in Lot 39 and 69 acres in Sec. 20, T. 7 N., R. 5 W., two miles northwest of Oakville at an elevation of 500 feet.

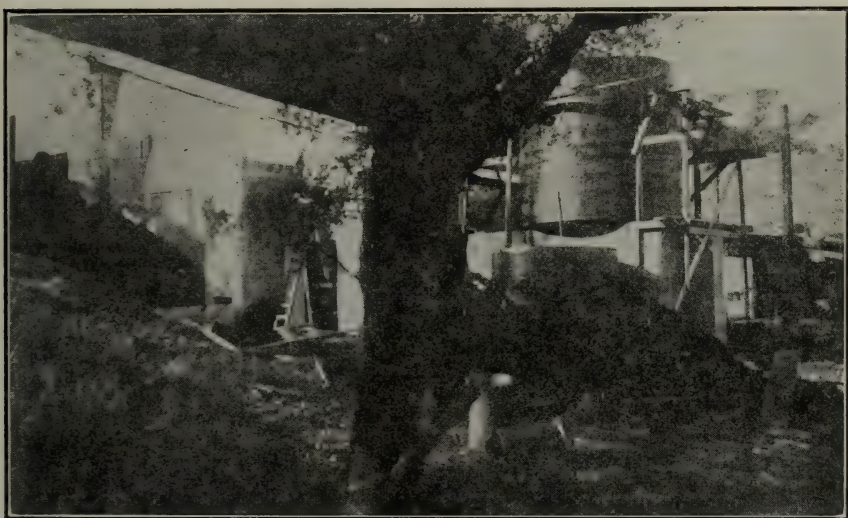
At the time of visit (November, 1928), a rotary furnace of 20 tons capacity per 24 hours was being installed; and the operators expected it to be operating in two weeks. Furnace and condensing system were designed by A. M. Thompson of the *Crown-Willamette Paper Co.* of Floriston, California. Vapors and products of combustion from the oil fire in the furnace go to a brick chamber containing a vertical tubular boiler, then to another brick dust chamber, then to a 10,000-gallon wood-stave tank that is divided into four compartments. The flow will be down one compartment, up the next, and so on to the stack on the last compartment. Baffles made of planks on edge, on which have been laid a layer of smooth boulders, are placed in the four compartments; and these are expected to aid in the condensation of the quicksilver. A spray of water is fed into the top of the tank. A fan between the second brick chamber and the tank serves as a booster to

<sup>1</sup>op. cit.

maintain the flow of gases. On March 15, 1929, eighteen flasks of quicksilver had been sold. All of the product of the condensing system was being reworked in a 'D' retort.

The main tunnel of the old workings had, at the time of visit, been cleaned out for a distance of 540 feet and timbered, 330 feet of this being in a southeasterly direction, the balance northwesterly. A small glory hole had been opened at a point about 350 feet westerly from the portal of this tunnel; and about 100 feet of tunnel has been driven from this glory hole. This work exposes a soft ore heavily stained by oxides of iron, in which some cinnabar can be seen. A trestle and ore bin have been built here. The operators expect some of the old dumps to yield a grade of ore that can be treated at a profit in the new plant.

Bibl: State Mineralogist's Reports IV, p. 336 (table); X, p. 362; XII, p. 364; XIII, p. 599; XIV, p. 286; Chap. rep. Bien. Period,



Thompson condensing system, under construction at Bella Oaks mine.

1913-1914, p. 114. State Min. Bur. Bull. 27, p. 76; Bull. 78, p. 80. U. S. Geol. Survey Mon. XIII, p. 377; Min. Res. 1909, Pt. I, p. 553; 1915, Pt. I, p. 269. Min. Res. W. of Rocky Mts., 1873, p. 11; 1874, p. 30.

*Calistoga Hot Springs.* (See above under Mineral Water.) Report XIII of the State Mineralogist states that globules of quicksilver were found in the marshy area near these springs.

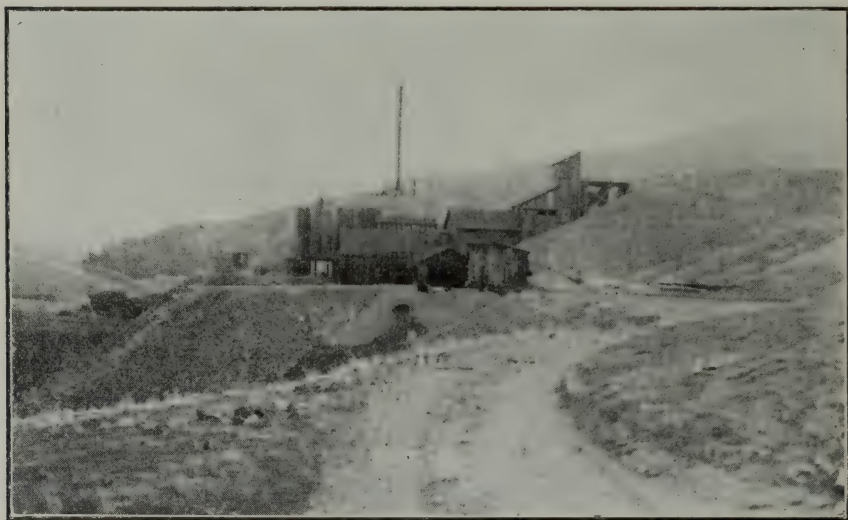
*Corona Mine.* Owner, *Vallejo Quicksilver Mining Company*, 342 Georgia Street, Vallejo. Location, Secs. 32 and 33, T. 10 N., R. 6 W., nine miles southeast of Middletown. Some work had recently been done by lessees at this mine, but at the time of visit, equipment, consisting of portable compressor, mine cars, etc., was being hauled away, and the mine was deserted. A geological map of this property is to be



found in Bulletin 78 of this Bureau, reprinted from Bulletin 27. It shows the croppings to be on the contact between a belt of serpentine and sandstone. The belt of serpentine is narrow, and is bounded on the opposite side by a tuff.

Bibl: State Mineralogist's Reports XIII, p. 597; XIV, p. 287; Chapter rep. bien. period 1913-1914, p. 114; State Min. Bur. Bull. 27, pp. 79, 206, 207; Bull. 78, pp. 81-82. U. S. Geol. Survey Min. Res., 1902, p. 252; 1908, Pt. I, p. 686.

*Granada Quicksilver Mining Company.* Maxie Jackson is president and Mrs. Geo. Anderson of Santa Rosa is secretary. This company has just been formed (March, 1929) to take over a prospect on the Yudnick and Polische property about 1200 feet easterly from the Oat Hill property. It was not visited by the writer. C. M. Butts, vice president, states that a tunnel, following a black tale seam as a hanging wall, was in ore for the full width of the working for a distance of about 25 feet,



New reduction plant at Knoxville Mine.

and that it was then turned and is now crosscutting this ore. No average samples have yet been taken.

*Knoxville Mine* (Boston, Redington). Owners, George E. Gamble and W. V. Wilson of Monticello, Napa County, California. Location, Secs. 6 and 7, T. 11 N., R. 4 W. The railroad point is at Napa, 48 miles south by dirt and macadam road, parts of which are soft when wet. This mine has been one of the largest producers in the state, but most of the production was made before 1883. Six thousand six hundred forty acres of patented land are held.

A new plant that was started in June, 1927, has produced 534 flasks of quicksilver from some of the old dumps, which were handled by means of a gasoline power shovel of one-third cubic yard capacity. The reduction plant consists of a 3-ft. by 40-ft. rotary furnace of a capacity of 32 tons per 24 hours. Condensers consist of 15-inch sewer-tile pipes



24 ft. long set on an incline. There are twelve of these; and the gases pass through them in pairs, up through two, then down through two, and so on. Four 10-ft. by 20-ft. redwood tanks with hopper bottoms discharging into a piece of 15-inch sewer-tile complete the condensing system. The furnace is equipped with a vibrating feeder; and a fan driven by a 3-h.p. motor sucks the gases from the furnace and discharges them into two cyclones to precipitate the dust. Power is furnished by a 15-k.v.a. generator driven by a 32-h.p. Fairbanks-Morse Diesel engine. This engine runs at a cost of \$5 per h.p.-month, nothing being charged for labor, because the furnace attendant runs the engine. Total operating costs per ton of ore, not including depreciation, were \$4.25, of which oil makes up about \$1.25. The reduction plant was not in operation at the time of visit in December, 1928.

Only development work will be done during the winter. At the time of visit, a tunnel had been driven a distance of 200 feet, and some very good ore was exposed in the bottom. Work was proceeding to determine the extent of this. The mine is equipped with a 9-in. by 8-in. compressor driven by a 32-h.p. gasoline engine. Seven men were employed, two on top and five in the mine. Wages are from \$4 to \$5 per day.

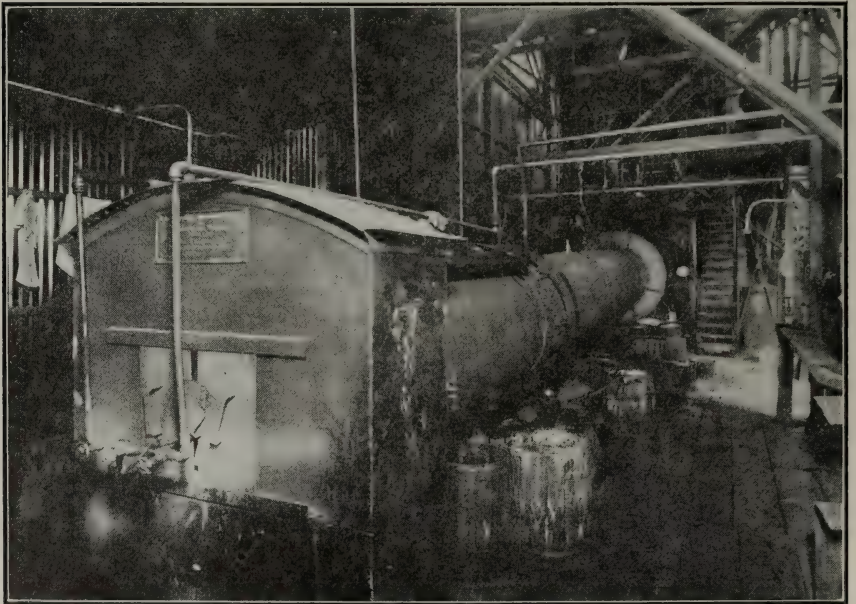
Bibl: State Mineralogist's Reports IV, pp. 179, 261, 289, 317, 329, 336 (table), 339, 340; VI, Pt. I, p. 122; X, p. 358; XI, pp. 69-71; XII p. 363; XIII, p. 599; XIV, p. 287; Chap. Rep. bien. period 1913-1914, p. 115; State Min. Bur. Bull. 27, pp. 76-79; Bull. 78, pp. 82-84. U. S. Geol. Survey Mon. XIII, pp. 10, 271-290, 464; Min. Res. 1883, pp. 394-396; 1884, p. 492; 1892, pp. 148, 160; 1902, p. 251; 1907-1912 (inc.), Pt. I. Geol. Survey of Cal., Geol. Vol. I, pp. 92, 99; Vol. II, pp. 128-132. Min. Res. W. of Rocky Mts., 1867, p. 178; 1868, p. 264; 1871-1876 (inc.). Trans. A. I. M. E., Vol. III, pp. 279, 285, 292, 301.

*La Joya Mine* is being operated by *Acme Mines and Mill, Inc.* W. E. Mooser is president; B. C. Austin is secretary; and the main office is in the Mills Building, San Francisco. Joe Garcia is superintendent of the mine. The location is in Sec. 24, T. 7 N., R. 6 W., in the rough foothills six miles west of Oakville, at an elevation of 1600 feet. The road is good in dry weather, but is soft when wet. The property consists of 10 patented claims of 185 acres and 480 acres of agricultural ground with mineral rights. This mine had been idle for many years when operations were started in 1915, and continued for several years. Present operations started in 1927.

The vein is an altered serpentine with a sandstone contact nearby. The width of the vein is 10 to 15 feet with occasional swells to 20 and 25 feet. It strikes northwest and dips 45° to 60° to the southwest. The outcrops of the vein are said to have been traced for a distance of about a mile on the surface. By means of a tunnel, one shoot of ore has been developed at a depth of 300 feet. It is 180 ft. long with an average width of 10 feet, and occasional swells to 25 feet. The management estimates the average value of this ore at \$15 to \$20 per ton, and that 40,000 tons have been developed. There is another shoot beyond this that has been developed only on the surface. Levels 1, 2 and 3 have respectively 100, 300 and 800 feet of drifting done on them.



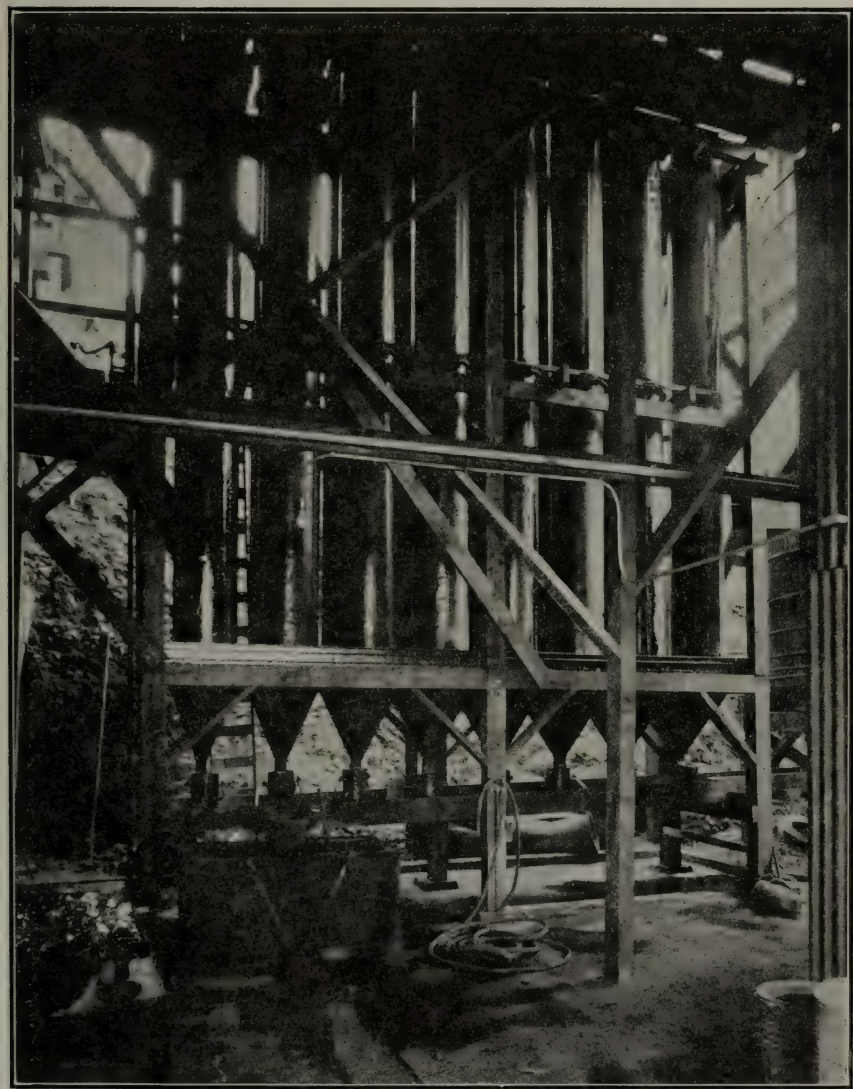
New reduction plant at La Joya Mine.



Rotary furnace at the La Joya Quicksilver Mine. Cyclone dust precipitator in the right background. Photo by courtesy of Acme Mines and Mill, Incorporated.



These levels are connected by means of a raise, and a winze in ore has been sunk 26 ft. below the 300-ft. level. The vein filling is an altered serpentine, containing quartz and cinnabar.



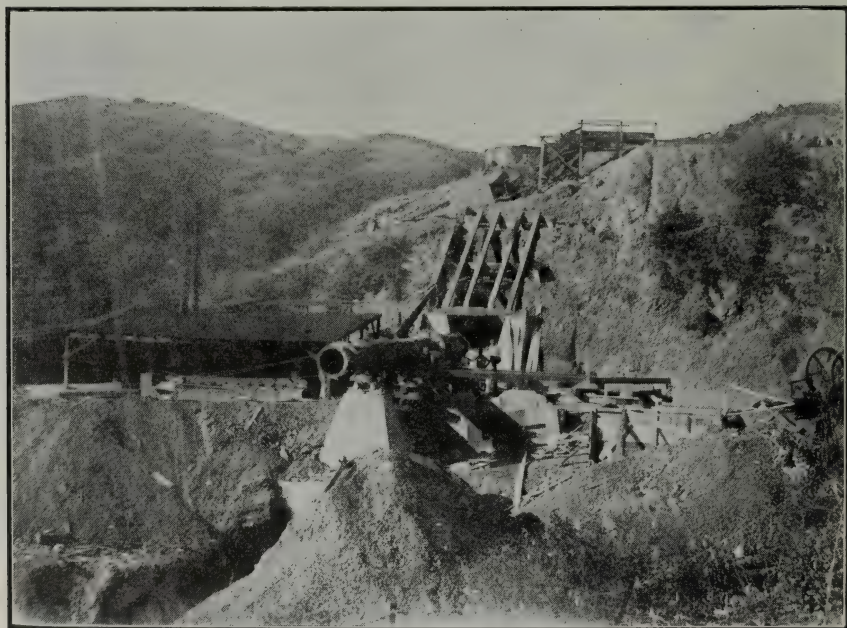
Metal condensers at the La Joya Quicksilver Mine. Soot is collected from the small buckets under each condenser, and is hoed with lime on the table in the left foreground. Photo by courtesy of Acme Mines and Mill, Incorporated.

Reduction equipment consists of a 3-ft. by 40-ft. Gould rotary furnace followed by a cyclone dust precipitator and vertical condensers of wrought iron pipe, 16 inches in diameter and 24 ft. high. The metal in these is about an eighth inch thick, and they are painted inside and outside with an acid-resisting paint. Water is sprayed into the stream





Rotary furnace being hauled to La Joya Mine.



Rotary furnace being placed on foundations at La Joya Mine.

of gas and vapor as it enters these condensers. After passing through these metal condensers, the vapor passes to three redwood tanks, 10-ft. by 20-ft., with cone bottoms, then to the stack. The quicksilver is recovered largely from the small iron buckets placed under the vertical metal condensers. Soot collected from these is hoed on an inclined table with lime; and the quicksilver runs out, no retorts being used. Power is furnished by a 25-h.p. Fairbanks-Morse Y type engine driving an alternating current generator. A similar engine of 37½-h.p. is being installed to drive a 10-in. by 10-in. Sullivan compressor. A 6-in. by 6-in. Sullivan compressor driven by a 5-h.p. motor furnishes air for the oil burner in the furnace. A fan driven by a 5-h.p. motor sucks from the cyclone dust precipitator and discharges into the metal condensers. A 7-h.p. motor drives the primary crusher, and a 5-h.p. motor drives the furnace.

Production amounts to 100–125 flasks of quicksilver per month. Twenty-four men are employed, 1 on top, 16 in the mine and 7 in the reduction plant. Wages for common labor are \$4 per day and for miners \$5 per day. H. W. Gould estimates the cost of treating ore in a 3-ft. furnace at \$1.35 per ton and in a 4-ft. furnace (100 tons per day) at \$1.15 per ton. The capacity of the 3-ft. furnace is estimated at 40 tons per 24 hours. Fuel oil is delivered for 6¢ per gallon.

Bibl: State Mineralogist's Report XIV, p. 288; Chap. Rep. bien. period, 1913–1914, p. 116; State Min. Bur. Bull. 27, p. 80; Bull. 78, pp. 84–86.

*Manhattan Mine.* (Lake.) This is assessed to the *Lake Mining Company*. It is located in Sec. 1, T. 11 N., R. 5 W., near the Knoxville mine. Production was made in 1862, and at intervals until 1916. Nothing is being done at present in the way of extracting minerals from this property, but it is leased as pasture-land. Bulletin 78 of this Bureau gives a description of the geology and workings, also a bibliography.

*Mountain Mine.* Location, Sec. 2, T. 6 N., R. 5 W., west of Yountville and south of the La Joya mine. No recent work has been reported on this prospect. See Bulletin 78 of this Bureau.

*Northern Light Prospect* is ½ miles west of Knoxville. No recent activity has been reported. See Bulletin 78 of this Bureau.

*Oat Hill Mine* (Napa Consolidated) is assessed to Norman B. Livermore, 1306 Merchants National Bank Building, San Francisco. Location, Secs. 22, 27, 28, 29, 32, 33, 34, T. 10 N., R. 6 W., nine miles southeast of Middletown by a good dirt road. The area is about 577 acres. Elevations on the property range from 1800 to 2750 feet. This mine was an important producer from 1876 until 1909, when it was closed by the Napa Consolidated. Production to date has been about 153,000 flasks of quicksilver. The mine has recently been acquired by the *Acme Mines and Mill, Inc.* (For other operations of this company see La Joya mine.) The cinnabar deposits occur entirely in sandstone which surrounds a core of basalt. The sandstone is soft, and all mine workings in it have caved and are entirely inaccessible.

H. W. Gould, who was the mine surveyor for about a year before it closed down, has recently made a report on the property for the Acme company. He thinks that a large tonnage of low-grade ore remains in the mine. At the time that the Napa Consolidated closed it down, 10



lbs. per ton was not a high enough recovery to cover expenses; and Gould says that the losses were high, so the metal content must have been 15 pounds per ton or better to be profitable. Quicksilver then sold at about \$38 per flask. He also thinks that it is safe to assume that the mine dumps contain 200,000 tons of ore of a grade ranging from 4 to 6 lbs. to the ton. This is based on an estimate made by R. P. Newcomb, who sluiced and concentrated the mine dumps in 1914 and 1915, and who is stated to have made an estimate of 250,000 tons of ore of a 3-lb. grade or better. This is said to have been based on his recovery, which was very low.

A Scott furnace of 40 tons capacity is on the property at present, but the condensing system has been dismantled, and must be replaced before the furnace can be operated. The Acme company has ordered a 100-ton Gould rotary furnace for this property, and expects to install this at once. Ed. Leister is superintendent.

Bibl: State Mineralogist's Reports V, p. 96; VIII, p. 413; X, p. 270; XI, pp. 65, 72; XII, p. 364; XIII, p. 598; XIV, pp. 289-291; XVII, p. 160; Chap. bien, rep. period, 1913-1914, pp. 117-119; State Min. Bur. Bull. 27, pp. 89-91; Bull. 78, pp. 88-90. U. S. Geol. Survey Mon. XIII, pp. 354-358, 469; Min. Res., 1883, pp. 394-397; 1884, p. 492; 1888, p. 97; 1892, pp. 145, 160; 1902, p. 251; 1906, p. 497; 1907, Pt. I, p. 679; 1908, Pt. I, p. 686; 1909, Pt. I, p. 553; 1910, Pt. I, p. 698; 1911, Pt. I, p. 902. Eng. & Min. Jour., Nov. 1, 1913, p. 828.

*Palisade Silver Mine.* (See under Silver.) Cinnabar has been found associated with the antimonial silver sulphide of this mine, but the ore has never been treated for the quicksilver.

*Patten Claims* (James Creek Placers), Mrs. M. F. Patten of Calistoga, owner. Placer gravels were formerly worked for cinnabar on James Creek, adjoining the Oat Hill group. There are said to be prospects in the sandstone also, but these have not been developed.

Bibl: State Min. Bur. Bull. 78, p. 90.

*Summit Mine* is in Sec. 19, T. 7 N., R. 5 W., three miles west of Oakville and south of the La Joya. It was a producer in the seventies, and some development work was done in 1916. No recent activity is reported. See Bulletin 78 of this Bureau, published in 1918.

*Twin Peaks Mine.* Owner, Twin Peaks Mining Company, c/o Louis D. Fay, 126 Kempton Ave., Oakland. Location: Sec. 33, T. 10 N., R. 6 W., and Sec. 4, T. 9 N., R. 6 W., about nine miles northeast of Calistoga. Cinnabar is found on a contact between sandstone and serpentine. The total output to the end of 1917 is reported to be 275 flasks. Some prospecting is said to have been started on this group recently by lessees.

Bibl: State Mineralogist's Report XIV, p. 291; Chapter rep. bien. period, 1913-1914, p. 119; State Min. Bur. Bull. 27, p. 92; Bull. 78, p. 91. U. S. Geol. Survey Ann. Rep. XXI, Pt. VI, p. 278; Min. Res., 1902, p. 252; 1907, Pt. I, p. 679; 1911, Pt. I, p. 902; 1915, Pt. I, p. 269.



*Whitney Prospect* is located in Sec. 21, T. 10 N., R. 5 W., in Snell Valley 10 miles southeast of Middletown. Sandstone impregnated with cinnabar is said to have been found on a contact with serpentine, and a few flasks of quicksilver to have been produced with a retort. See Bulletin 78 of this Bureau, published in 1918.

#### SILVER

*Banner Development Company* (See Palisade Mine).

*Palisade Mine.* Owner, *Palisade Mines Company*, H. J. Langdon, president, Balfour Building, San Francisco. Location, Sec. 24, T. 9 N., R. 7 W., three and a half miles north of Calistoga by good roads, and at an elevation of 625 ft. (bar.). The mine is being operated at the present time by the Banner Development Company, of which Sigmund Janas is president and B. Flynn is secretary. The main office is at 57 Post St., San Francisco. Lloyd L. Root is manager, P. H. Hickey is general superintendent, and H. V. Wallace is engineer.

Two fissure veins, the Easley vein and the Palisade vein, are found in an andesite country rock. They are filled with quartz carrying sulphides of silver and a little gold. Both veins strike N. 6° E. The Easley is from 4 ft. to 15 ft. wide and dips 63° to 75° to the west, while the Palisade has an average width of 4 ft. and dips 57° to the west. The Palisade vein is at a distance of 150 ft. from the Easley on the 270 level, and is on the footwall side. These relations indicate that there may be a junction of the two veins below that level. Two ore shoots have been mined on the Easley vein on the 270 level; No. 1 is 100 ft. long and No. 2 is 80 ft. long. The present operators think that these two shoots may unite at greater depth. On the lowest level, the 320, the No. 2 shoot is 150 ft. long.

The mill and the main shaft are in different gulches with a ridge between. The mill tunnel level has been driven through this ridge from the mill to the shaft, and has followed the Easley vein for a distance of 920 feet. From the main shaft, levels have been driven as follows: an intermediate below the mill tunnel level, 100, 160 and 270 levels. From the 270 level a winze has followed the vein to the 320 level. Drifting on the levels from the main shaft average 750 ft. on each level. Raises and winzes connect all levels; and all but the 320 are connected to the main shaft, also.

Equipment consists of a 14-in. by 16-in. single-stage compressor driven by a 100-h.p. motor, 30-h.p. hoist on the main shaft, assay equipment, machine shop and living accommodations for 30 to 40 men. The property was equipped with a mill using the Vandercook cyanide process. This has been remodeled by the present operators to use flotation, and now consists of the following: Blake crusher, 10-in. by 12-in., and bucket elevator driven by 30-h.p. motor, one No. 54 Marcy mill driven through reduction gearing by a 50-h.p. motor, one 5-ft. by 16-ft. tube mill with Duplex Dorr classifier and driven by a 75-h.p. motor, new six-cell Kraut flotation machine, Oliver filter, 10-ft. by 12-ft., for tailings. Another Oliver filter, 5-ft. by 4-ft. is to be installed for dewatering concentrates. Tailings are stacked. Three Vandercook thickeners, 10-ft. by 20-ft. that were used in the cyanide process are

available for use if needed. Power is bought from the California Telephone and Light Co.

Parts of the vein remain in place from the mill tunnel level to the outcrop, 272 ft. above; and the present operators plan to mine these and treat the ore in the flotation mill. The winze from the 270 level to the 320 level is to be extended upward to the mill tunnel level by timbering through the stopes and by raising, and is to be equipped with a hoist and made the main working shaft. This will save handling ore from the lower levels several times. The winze is also to be deepened in the expectation of developing new ore reserves. About 20 men are employed.

Bibl: State Mineralogist's Reports V, p. 93; VI, Pt. I, p. 77; VIII, pp. 413-415; X, p. 363; XII, p. 376; XIII, p. 606; XIV, p. 270; XVII, p. 158. U. S. Geol. Survey Mon. XIII, p. 370.

*Silverado Mine* (Calistoga) (Mount St. Helena Mine). Owner, Harry Patten, Calistoga, R. F. D. Location, Sec. 2, T. 9 N., R. 7 W., five miles north of Calistoga on the southeast slope of Mt. St. Helena. The mine was opened in 1872; and a 10-stamp mill operated four months in 1874 with a production of \$93,000 from 2300 tons of ore. The vein strikes about north and dips 73° west; and is from 4 ft. to 12 ft. wide. Patten says that at the present time 40,000 tons of \$12 ore is blocked out as the result of spending \$12,000 on development in 1927, that No. 1 tunnel, 400 ft. below the outcrop has followed a 12-ft. width of \$10 ore for a length of 75 ft., and that the No. 2 level has been driven ahead 90 ft. on a 4-ft. to 4½-ft. width of ore with 75 ft. of backs. About \$2.70 per ton is in gold, the balance is silver. He expects to stope this ore, and mill it in the new flotation plant of the Banner Development Company at the Palisade mine.

Equipment consists of a 2-drill Rix compressor driven by a gasoline engine, or bins, chutes, etc., ready to ship ore by truck. Power can now be obtained from a line of the Pacific Gas and Electric Company that crosses the property; and Patten plans to change his compressor to motor drive and install crushers, with which to do the primary crushing at the mine, before starting shipments.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 77; X, p. 363; XII, p. 376; XIII, p. 606; XIV, p. 270; XVII, p. 159. U. S. Geol. Survey Min. Res. W. of Rocky Mts., 1874, pp. 63-65; 1875, p. 178; Mon. XIII, p. 370.

#### STONE INDUSTRY

Many small quarries formerly operated in Napa County, producing blocks for use in the erection of cut-stone buildings and bridges, and crushed stone for road and concrete work. Very little cut stone is being used at the present time on account of the high labor cost; and the crushed stone production has largely been concentrated at the quarry of the Basalt Rock Co., which is equipped to operate on a large tonnage basis.

*Bachelder Quarry*, C. S. Bachelder, Napa, owner. It is located on the east edge of the town at an elevation of 100 feet. The rock is a reddish rhyolite.



*Basalt Rock Company, Inc.*, formerly known as L. J. Alexander Co., is located three miles due south of Napa. A. G. Streblow is president and is in charge of operations. Harry Morris is secretary. The main office is at Napa.



Quarry and tramway of Basalt Rock Company.



Crushing and screening plant of Basalt Rock Company.

The quarry in this basalt rock was started by hand in 1921, and operations have been continuous since that time. The present plant was built about 1923. The company owns a continuous strip of land, 8300 ft. long, from the quarry to the Napa River. One hundred sixty acres are owned at the quarry, 40 acres on the river; and the strip from



the quarry to the State highway contains 240 acres. The rock is removed from the quarry by steam shovels and trucks. It then goes through the 30-inch primary gyratory crusher at the quarry, then on a 3000-ft. aerial cable tramway to the secondary crushers and vibrating screens. Symons crushers are used for the final reduction. After passing through this plant, which is located near the State highway, the product is transported on an aerial cable tramway about a mile long to bunkers on the Napa River. Railroad cars and barges can be loaded at these bunkers. The capacity of the plant is that of the tramway, 110 tons per hour. The track cable is  $\frac{7}{8}$  inch on the loaded side, and  $\frac{5}{8}$  inch on the return; and the haul cable is  $\frac{5}{8}$  inch. The buckets have a track cable on each side of them, and after dumping, return upside down. They are of 21 cu. ft. capacity and travel at a speed of 300 ft. per minute. The production is from 800 to 1000 tons in nine hours; and the total for the year, 1927, was 186,000 tons.

This company owns 80 acres of volcanic ash in a location handy to the present tramway, but, at present, has no facilities for fine grinding.

*Bieber Quarry* is owned by Alice Bieber of St. Helena. It is one mile northwest from St. Helena post office and  $\frac{1}{4}$  mile from the county road, at an elevation of 500 feet. The rock is basalt, and was quarried at one time for paving blocks.

*Butala Gravel Pit.* See Thorsen.

*Davis Quarry* is two miles from St. Helena on the Sanitarium road. It produces a hard reddish trachytic tuff that has been used locally for building purposes.

*Errington Quarry* is owned by Ray E. Errington of Napa, and is located one and a quarter miles east of Napa. Errington uses material from this quarry largely in his own work on contracts for road and concrete work. The basalt rock is loaded on trucks with forks to obtain a clean product, and then goes to the crushing plant consisting of a No. 4 Gates crusher and bucket elevator feeding screens. Four sizes are kept separate,  $\frac{1}{4}$ ,  $\frac{3}{4}$ ,  $1\frac{1}{2}$  and  $2\frac{1}{2}$  inch. The capacity is 100 cubic yards in eight hours.

*Gardner Quarry* is in Wooden Valley about 10 miles northeast of Napa. A light buff colored, fine-grained sandstone has been produced for building bridges and for road metal.

Bibl: State Mineralogist's Reports XIII, p. 636; XIV, p. 295; State Min. Bur. Bull. 38, p. 131.

*Howell Mountain Quarry* is owned by H. Overacker of St. Helena. It is located on the Glendale ranch, three miles northeast of St. Helena, and has produced trachytic tuff for use as building stone.

Bibl: State Mineralogist's Reports IX, p. 291; XIII, p. 640; XIV, p. 295; State Min. Bur. Bull. 38, p. 156.

*Lenz Quarry* is owned by S. Lenz of St. Helena. It is on the Calistoga road, two miles north of St. Helena. The rock is basalt, and is being used at present in concrete work.

*Napa County* owns and operates two quarries for the production of crushed rock for road work. One is the Stice quarry, six miles from

Napa on the Sonoma road; the other is located one mile northwest of Yountville.

Bibl: State Mineralogist's Report XIV, p. 297.

*Napa Sandstone Company* is owned by J. B. Newman of Napa. Sandstone was quarried in 1901 and 1902 for bridge construction and rough building operations.

Bibl: State Mineralogist's Report XIV, p. 297; State Min. Bur. Bull. 38, p. 132.

*Newman Quarries.* J. B. Newman of Napa owns two quarries of trachytic tuff; one is on the Berryessa road, five miles northeast of Napa; the other is three miles southeast of Napa, back of the State asylum. The stone has been used for bridges and foundations.

Bibl: State Mineralogist's Report X, p. 361; XIII, p. 640; XIV, p. 297; State Min. Bur. Bull. 38, p. 157.

*Olsen Quarry* (see Zollner).

*Phelan Quarry* is an old sandstone quarry, four miles south of Monticello on the west side of Berryessa Valley.

Bibl: State Mineralogist's Report XIV, p. 297; State Min. Bur. Bull. 38, p. 132.

*Rose Quarry*, D. C. Willis, Calistoga, agent. This quarry formerly produced a trachytic tuff.

Bibl: State Mineralogist's Report XIV, p. 297; State Min. Bur. Bull. 38, p. 157.

*Southern Pacific Company Gravel Pit.* This company formerly operated a power shovel in the bed of the creek just south of St. Helena to obtain sand and gravel, but the pit has been abandoned.

Bibl: State Mineralogist's Report XIV, p. 297.

*Thornsen Gravel Pit.* Harry Thornsen of St. Helena has a pit, from which sand and gravel are obtained, in the bed of Sulphur creek south of St. Helena. Joseph Butala, Miss Margaret Watt and Mrs. H. E. Weinberger, all of St. Helena, own similar pits.

Bibl: State Mineralogist's Report XIV, p. 298.

*Tychson Quarry.* Mrs. J. Tychson of St. Helena owns a quarry two miles northwest of St. Helena, from which basalt paving blocks were formerly produced.

Bibl: State Mineralogist's Report XIV, p. 298.

*Watt Gravel Pit* (see Thornsen).

*Weinberger Gravel Pit* (see Thornsen).

*Wing Quarry.* The heirs of H. W. Wing of Napa own a quarry on the Berryessa road, six miles northeast of Napa, that has produced some of the trachytic tuff used in the construction of bridges. It adjoins the Newman quarry.

Bibl: State Mineralogist's Reports XIII, p. 640; XIV, p. 298; State Min. Bur. Bull. 38, p. 158.

*Zollner Quarry* is owned by the estate of J. F. Zollner. It is two and three-quarter miles south of Napa, and has produced both basalt and a hard gray trachyte.

Bibl: State Mineralogist's Reports XIII, p. 633; XIV, p. 298; State Min. Bur. Bull. 38, pp. 158, 320, 342.

In addition to the above quarries, the following occurrences of stone have been noted:

Sandstone occurs in Maxwell Canyon, Pope Valley, 15 miles north of Rutherford, on the Maxwell and Hardin Ranches; also in Gordon Valley, 11 miles east of Napa.

Columnar basalt occurs in Clark's Canyon, 12 miles west of Napa. Charles Clark of Napa is the owner. Another occurrence is found on the east slope of Mt. St. Helena, six miles west of Kellogg.

Steatite and serpentine occur in Chiles Valley, northeast of Rutherford. In the museum of the State Mining Bureau, is a specimen of steatite (soapstone), from the Fir Hill ranch, two miles west of Chiles post office.

A light-colored volcanic tuff has been quarried for building purposes from a point one-half mile west of the Corona quicksilver mine; but it was soft, and did not weather well.

Bibl: State Mineralogist's Reports V, p. 107; XII, p. 399; XIII, pp. 612, 639; XIV, p. 299; State Min. Bur. Bull. 38, p. 131.

#### VOLCANIC ASH

Under the name of 'Callustro,' volcanic ash from a deposit three miles west of Calistoga was sold years ago. It was ground on the property and was sold as a polishing powder. Nellie Sharpstein is the present owner.

Bibl: State Mineralogist's Reports X, p. 362; XIV, p. 299.

*Basalt Rock Company* (see under Stone Industry). This company has a large, undeveloped deposit of volcanic ash.

#### SAN FRANCISCO COUNTY

By C. MCK. LAIZURE, Mining Engineer

San Francisco County, created in 1850, was originally much larger than it is at the present time, for it then included, in addition to its present area, three-fourths of the territory of what is now San Mateo County.<sup>1</sup>

The act providing for the formation of San Mateo County in 1856 placed the boundary line between the two counties through Shag Rock, but the following year it was changed slightly to coincide with the line between townships 2 and 3 south, M. D. Meridian and Base. Jurisdiction over a portion of the bay waters also passed from San Francisco County to Marin and Alameda counties when other changes were made in 1854, 1868 and 1873.

As now defined the land area of the consolidated city and county of San Francisco comprises approximately 46½ square miles occupying

<sup>1</sup> Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.



the extreme north end of the peninsula separating the Pacific ocean from the south arm of San Francisco Bay.

The topography and geology of the county are described in detail in U. S. Geologic folio No. 193, San Francisco, to which the reader is referred. For the most part its topography is hilly, the principal formations present being Franciscan metamorphic sandstones, shales, cherts and serpentine, with some basalt and small areas of unconsolidated alluvium.

The mineral industry looks upon the city with its thousands of manufacturing plants and commercial activities as a consuming and distributing point for mineral products, and as a financing center, rather than as a producer of raw products. Yet the mineral output of this small and closely built up area from 1894 to 1927 inclusive, as shown by the tabulation herewith, has amounted to more than seven million dollars. Miscellaneous stone (crushed rock) accounts for the greater part.

#### MINERAL PRODUCTION OF SAN FRANCISCO COUNTY, 1894-1927.

Year	Brick		Miscellaneous stone <sup>1</sup> , value	Miscellaneous and unapportioned		
	M	Value		Amount	Value	Substance
1894.....			\$296,864	20 tons	\$25	Limestone.
1895.....			379,696			
1896.....	5,000	\$37,500	285,167			
1897.....	4,500	28,500	86,217			
1898.....			129,595			
1899.....			275,604			
1900.....			58,400			
1901.....			156,947			
1902.....	25,800	238,800	156,300			
1903.....	33,403	294,326	508,460			
1904.....	39,509	367,911	332,220			
1905.....	32,585	310,685	114,357			
1906.....	7,208	58,289	106,250	8,500 tons	10,500	Glass sand.
1907.....	44,578	434,140	97,273	4,000 tons	60,000	Asphalt.
1908.....	41,837	345,155	95,259	1,500 tons	15,000	Asphalt.
1909.....	31,430	221,332	150,382	850 tons	9,800	Asphalt.
1910.....			108,126	1,000 tons	30,000	Unapportioned, 1900-1909.
1911.....			119,636		12,000	Asphaltum.
1912.....			151,147			
1913.....			110,551			
1914.....			119,889			
1915.....			128,270			
1916.....			76,437			
1917.....			107,957			
1918.....			16,463			
1919.....			65,541			
1920.....			77,553		2,800	Other minerals.
1921.....			41,562			
1922.....			2		65,409	Pumice, miscellaneous stone.
1923.....			117,341			
1924.....			150,258			
1925.....			131,158			
1926.....			112,193			
1927.....			62,700			
Totals.....	265,850	\$2,336,638	\$4,925,863		\$205,509	

<sup>1</sup>Includes crushed rock, rubble, sand, gravel

#### MINERAL RESOURCES

As may be expected metalliferous deposits of economic importance are absent and commercial nonmetallic deposits are very restricted in variety. Occurrences of more than 30 different minerals, however, have been noted in the county, showing this area to be not without some

interest from the standpoint of the collector or mineralogist. Among these minerals may be mentioned actinolite, apatite, apophyllite, aragonite, barite, brucite (rare and only reported from one other county), calcite, cinnabar, gold, gypsum, hydrodolomite, hydromagnesite, ilmenite, jasper, lignite, magnesite, magnetite, mercury, opal, pyrolusite, pyrite, quartz crystals, serpentine and titanite, as well as some other rock-forming minerals.

Among the specimens from San Francisco County in the Museum of the Division of Mines and Mining are: quartz crystals, lignite from Telegraph Hill, an indurated clay containing 21.33%  $\text{Al}_2\text{O}_3$  from near Filbert and Leavenworth streets, hydromagnesite from a Market street cut near Guerrero street and at Fort Point, four samples of manganese oxides, pyrolusite of good quality from the Potrero district, another from just south of St. Mary's College, another from Hunters Point and psilomelene from Hunters Point, gypsum crystals from along the ocean beach, three specimens of cinnabar, a large and rich one obtained near the corner of McAllister and Divisadero streets and two others not as high grade from different localities. Two samples of auriferous metamorphic rock, one from Mission Hills, and another quartzose rock with calcite and pyrite from a point near the San Mateo line are also on exhibit.

Gold occurs in the black sands along the ocean beach at the mouth of Laguna del Merced. Some attempts were made to work the black sands many years ago with varying degrees of success, but the richer portions were soon worked out after which the beach was abandoned.

#### FOUNDRY SAND

In the early days of the foundry business considerable sand suitable for heavy rough castings was obtained locally within the county, but the present output is almost negligible.

*The Daniel Gallagher Company*, 172 Beale Street, San Francisco, still occasionally take out small quantities from various building and grading excavations, mainly in the southern part of the county.

*Industrial Mineral Products, Inc.*, W. B. Vestal, general manager, 970 Seventh Street, San Francisco, mined a deposit and operated a blending plant on Paul Avenue from 1924 until October, 1927, at which time the plant was moved to a deposit in South San Francisco, which is described under San Mateo County.

#### PUMICE AND VOLCANIC ASH

*Silica Mine.* A deposit of medium coarse-grained, light-gray volcanic ash, a variety of pumice, situated on the property of Spring Valley Water Company, has been mined and utilized by the Spicky Polish Corporation in the manufacture of a cleansing compound. The construction of a golf course in 1923 caused operations to be abandoned at that time.

#### STONE INDUSTRY

This industry, which includes crushed rock, sand and gravel operations, has existed in the county since the settlement of the city of San Francisco began, and many rock quarries have been opened up at

various points. Sand and rock were first used to fill in the bay and other low areas, and later for ballast, macadam, concrete and rubble. Most of the old quarries have been abandoned due to the growth of the city, or to being worked out. The rock quarried and crushed was generally a blue metamorphic sandstone common to the Coast Range, chert or jasper. A little stone suitable for ashlar has also been produced. At the present time there is only one active commercial quarry.

Bibl: State Mineralogist's Reports XII, pp. 389-390; XIII, pp. 625-626; XVII, pp. 164-165; State Mining Bureau Bull. 38, pp. 320-322.

*Mission Quarry Company.* This company, of which A. Borland is president, and C. S. Chase, secretary, with office at 210 Balboa Building, San Francisco, owns and operates Mission Quarry, comprising seven acres on Geneva avenue, about one mile south of Mission street.

The rock is a hard gray metamorphosed sandstone, mined by open cut caving system, usually enough rock being broken down in one blast to keep the crusher supplied for several months. A portable compressor is used to furnish air for drilling.

The rock is crushed in a No. 6 Gates gyratory, crushing to 2-inch size, elevated and screened, the oversize passing to a No. 4 Gates gyratory. All machinery is operated by electric power. The bunkers have a total capacity of about 1000 yards. Operation has been more or less intermittent during the past year; from one to fifteen men being employed at different times.

## SAN MATEO COUNTY

By SAM P. SENIOR, JR., Mining Engineer

### INTRODUCTION

San Mateo County, created April 15, 1856, and comprising 447 square miles, is a peninsula county lying directly south of San Francisco, with the Pacific Ocean to the west and San Francisco Bay to the east; Santa Clara and Santa Cruz counties adjoin it on the southeast and south, respectively. Its total assessed valuation in 1928 was \$51,926,529, an increase of \$13,445,500 over the figure for 1920. The total population as estimated for January 1, 1929, is 63,125.

The principal cities are Burlingame, San Mateo, Redwood City, South San Francisco and Daly City, with population of 9847, 9768, 7971, 6794, and 5795, respectively. Burlingame is situated 18 miles south of San Francisco, close to the bay shore. Redwood City, the county seat, is located 9 miles south of the city of San Mateo at the edge of the marshes and has a deep-water frontage on a channel which comes in close to the center of the city. This gives desirable manufacturing sites, and several large factories were established here years ago.

The centers of population follow the line of the Southern Pacific Railroad down the east side of the peninsula to its southern boundary. The county is famous mostly for its development into homesites for San Francisco people. This is due to its splendid climate, attractive surroundings, and its proximity to San Francisco. Besides the Southern Pacific Railroad, the United Railroad Company of San Francisco operates an electric line down the peninsula to the city of



San Mateo. The state highway, and the Bayshore Highway, rapidly nearing completion, make the county very accessible. Rainfall averages 20 inches in San Mateo.

On the west coast the climate is more vigorous, high winds and fog being common. This coast is more rugged and consequently less populated; however, the rich soil on the west slope of the mountains extending to sea level is rapidly making it famous as a farming section, especially for truck gardening.

#### TOPOGRAPHY AND GEOLOGY

San Mateo county is traversed by two distinct mountain groups, both having a general northwest trend and being separated by the Merced Valley, which terminates in Merced Lake, the greater part of which lies in San Francisco County. The northern group, the highest point of which is San Bruno Mountain (elevation 1315 feet), extends into San Francisco. The southern group is a continuation of the Santa Cruz mountains and culminates in Montara Mountain, the highest peak being 1952 feet in elevation.

Quoting from the report of Lawson,

"In character of relief these two blocks present an interesting contrast. The surface of the northern block is irregularly hilly and, except in San Bruno Mountain, shows but little linearity in the disposition of its crests and valleys. Its geomorphy is fairly mature, although a characteristic feature of that maturity is a certain ruggedness of profile due to the presence of formations composed of radiolarian chert. The exceptional resistance which these offer to erosion causes the areas they occupy to present a marked contrast with adjoining areas composed of sandstone. \* \* \*

"The southern block is marked by notable linearity in its crests and valleys and its geomorphy is in general much less mature than that of the northern block. The most remarkable feature is the valley in which lie San Andreas and Crystal Springs lakes, a short segment of the San Andreas rift valley, a feature due to repeated faulting in recent geological times. The trace of the fault of 1906 follows this rift for 300 miles. The valley is due in part directly to earth movement, but in large measure also to the mashing of the rock in the fault zone and its consequent easy erosion. Northeast of the San Andreas rift lies the equally linear Buriburi Ridge which slopes down to Merced Valley and to the Bay of San Francisco. The slope of the Montara orographic block in the area southwest of the rift valley is dissected by a series of subparallel steep-sided canons and intervening ridges, which are in large part remnants of the original tilted surface. Viewed in a large way, however, this tilted slope, taken as a whole, from the crest of Montara Mountain to the Bay of San Francisco, presents a broadly terraced aspect. It comprises two terrace levels or steps, one the flat-topped ridge that is elsewhere called the Buriburi Plateau, the general elevation of which is about 700 feet, and the other the Sawyer Plateau, comprising a number of flat-topped ridges that stand at elevations of 1100 and 1200 feet.

"The crest of the tilted block known as Montara Mountain is composed of quartz diorite and is somewhat serrate in its longitudinal profile, its serration being due to its incision by the head water erosion of the high grade streams on its southwest front. On the precipitous shoulders and ridges of the southwest face of the mountain there are obscure traces of terraces at elevations of 400 and 500 feet. At the base of the mountain front, but separated from it by an alluviated valley, is a low ridge known as Miramontes, terminating in Pillar Point. This ridge is composed of folded late Pliocene strata which rest upon the quartz diorite."

The geology of San Mateo County will not be repeated here, as it has already been fully described, partly in the folio cited above and partly in the Santa Cruz Folio No. 163, to which the reader also is referred.

#### DRAINAGE AND WATER SUPPLY

San Mateo Creek is the most important drainage channel in the county. It cuts across the Buriburi Ridge, flowing through a deep gorge northeastward to San Francisco Bay, draining the valley of the San Andreas rift both to the northwest and the southeast of its head in Crystal Springs Lake. The creek is dammed at the lake, the latter

<sup>1</sup> Lawson, A. C., Geology of the San Mateo Quadrangle; U. S. G. S. Folio No. 193.

forming a large reservoir whose waters are used to partly supply San Francisco and a few of the cities along the east side of the peninsula. Pilarcitos Creek, which rises in Pilarcitos Lake, forms the drainage basin for the west slope of Cahill Ridge and the east slope of Montara Mountain. It flows in a general southerly direction, emptying into the ocean at Half Moon Bay. Numerous small perennial streams flow down from the west slopes of Montara Mountain group to the ocean, affording an ample water supply for that coastal region; the most important of these being the San Gregorio, Pescadero and Purissima creeks.

#### MINERAL RESOURCES

By far the most important mineral resource of the county is cement. The lime is derived from extensive deposits of oyster shells in San Francisco Bay. Next in importance are salt, building materials, crushed rock, sand and gravel—grouped under the heading of stone industry. Surface water impounded by dams in stream valleys has been extensively used to supply the peninsula cities and towns. In addition to the above minerals, asphalt, petroleum, clay, gems, and small occurrences of barytes, chromite, gold, silver and quicksilver are known. The total recorded mineral production from 1895 to 1927, inclusive, was \$11,038,761. The production for 1927 was \$1,863,838, San Mateo County ranking twentieth on the list of California counties.

#### BITUMINOUS ROCK

*Hooper Quarry.* There is a small bituminous rock quarry located in Sec. 8, T. 8 S., R. 3 W., about 2 miles north of the county line between San Mateo and Santa Cruz counties. It was owned by John A. Hooper, and some rock was used for private road work.

#### BRICK, CLAY, CHROMITE AND GEMS

Bibl: See Rept. XVII, 1920, San Mateo County.

#### CEMENT

*Pacific Portland Cement Co.*, Robert B. Henderson, president; J. B. Colton, vice president; home office Hunter-Dulin Building, 111 Sutter street, San Francisco.

This company's original San Mateo County plant was located and built on the shore of San Francisco Bay at Redwood City in 1924. In 1927 the second section of the mill was completed, together with plants for the manufacture of agricultural lime and ground shell. The entire plant, built by the Foundation Company of New York, is of concrete, and the materials in the process of manufacture are handled in the straight line method, requiring a minimum of transportation from the time they are received until the finished product is ready for shipment.

The raw materials used in the manufacture of cement consist of oyster shells in extensive deposits in San Francisco Bay, together with silt or clay washed down from the surrounding hills. The oyster shells are pure lime, and the other necessary elements, silica, alumina and iron, are contained in the clay in the proper proportions for cement making. These shell and clay beds were acquired by the company several years ago and embrace over 30,000 acres—practically

## MINERAL PRODUCTION OF

	Salt		Brick	
	Tons	Value	M	Value
1895.....				
1896.....				
1897.....				
1898.....			1,140	\$7,000
1899.....			2,870	24,225
1900.....			225	9,000
1901.....	40	\$400	500	9,070
1902.....	6,500	16,000	200	8,000
1903.....	7,700	25,000	3,100	77,500
1904.....	12,000	62,500	3,902	56,436
1905.....	16,000	67,500	5,902	61,436
1906.....	14,900	44,920	6,613	67,000
1907.....	14,000	56,000	8,078	86,285
1908.....	23,800	60,900	4,494	63,231
1909.....	22,100	95,400	1,346	38,405
1910.....	26,000	64,750	1,350	37,250
1911.....	27,500	55,000	1,350	43,000
1912.....	33,000	80,000	1,400	40,500
1913.....	28,000	72,250	1,418	44,680
1914.....	27,500	76,750	950	24,074
1915.....	25,500	63,750	715	19,550
1916.....	28,540	70,807	986	38,121
1917.....	36,483	114,689		
1918.....	26,434	144,604		
1919.....	30,238	136,190		
1920.....	37,409	206,897		
1921.....	32,587	167,022	*	
1922.....	32,428	149,302		
1923.....	35,757	199,192		
1924.....	51,258	205,176		
1925.....	31,325	155,925		
1926.....		*		
1927.....		*		
Totals.....	\$630,089	\$2,360,924	*16,539	\$754,763

\*The limestone produced in San Mateo County is used as crushed rock and is included under Stone Industry. Previous to 1915 it was erroneously classified as industrial limestone and tabulated under that heading.

\*Includes crushed rock, rubble, sand, gravel.

\*See under 'Unapportioned.'

the entire floor of South San Francisco Bay, on both sides of the channel from Millbrae to Alviso, and the deposits probably offer a sufficient quantity of raw material to supply the plant for several hundred years.

The shells and clay are taken from the bay by means of suction dredges, through a sixteen-inch pipe on to barges alongside the dredge. These are conveyed to the unloading wharf at the plant. The dredges with operating forces of from six to ten men each replace the usual 75 to 100 men required for quarrying operations where limestone is used for the raw material, and also does away with the usual heavy quarrying expenses such as blasting, steam-shovel operation and heavy crushing machinery.

From the barges the shells are removed by an overhead crane with a traveling bucket to the raw-grinding mills, and are then carried into



## SAN MATEO COUNTY, 1895-1927.

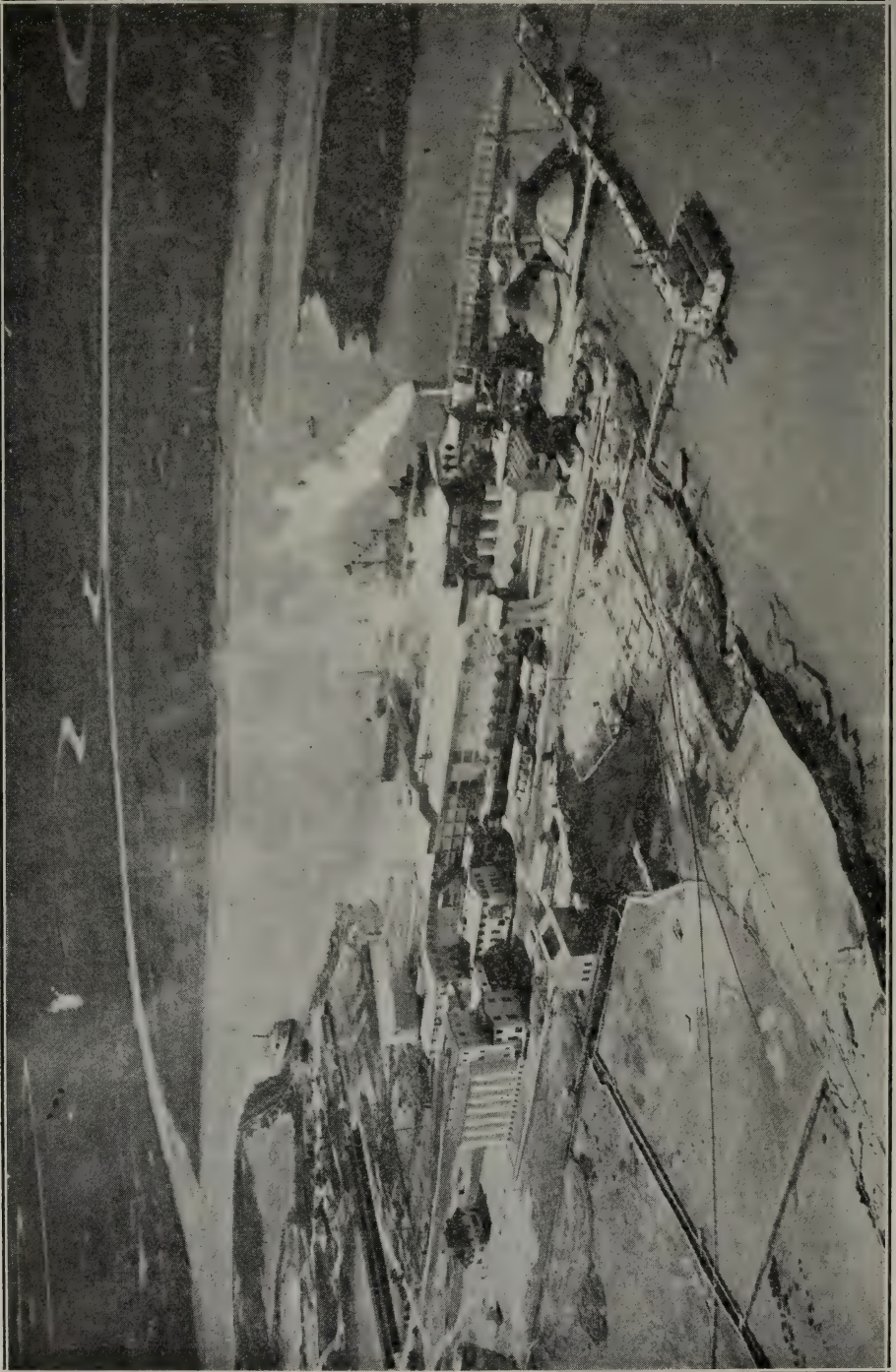
Limestone		Miscellaneous stone?, value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
			5,000 tons	\$5,000	Clay.
			1,000 bbls.	1,250	Petroleum.
			500 bbls.	1,250	Cement.
		\$40,000			
		70,000			
		34,000			
		7,500			
		6,000	17 tons	255	Asphalt.
		301,120	5,000 tons	5,625	Clay.
		150,000			
		113,866	3,000 bbls.	6,000	Petroleum.
		75,000			
		111,823			
		2,111			
37,687	\$17,451	89,142			
120,306	96,245	90,221		500	Gems.
111,382	89,108	88,766			
93,500	74,800	61,185			
102,300	66,495	29,587			
138,544	78,506	18,635			
153,329	75,941	34,648	81,000 tons	34,120	Gems.
			6,581 bbls.	845	Sandstone.
				200	Lime.
				100	Gems.
		93,391		1,100	Other minerals.
			593 tons	732	Pottery clay.
		25,663		85	Gems.
		71,668		150	Gems.
				20,656	Brick and tile, magnesium chloride, potash.
		34,164		15,044	Magnesium chloride, potash.
		42,235		63,246	Other minerals.
		46,040	322 bbls.	966	Petroleum.
		61,697	322 bbls.	39,200	Magnesium salts, potash.
				966	Petroleum.
				27,407	Brick, magnesium chloride, potash.
		60,009		34,384	Magnesium salts, petroleum, potash.
		96,815		33,809	Magnesium chloride, petroleum, potash.
		75,078		21,917	Gems, magnesium chloride, petroleum, potash.
				1,330,831	Cement, gems, magnesium chloride, natural gas, petroleum, potash.
		77,470		1,816,383	Cement, magnesium chloride, natural gas, petroleum, salt.
		129,802		1,734,036	Cement, limestone, natural gas, petroleum, salt.
757,048	\$408,544	\$2,227,673		\$5,196,857	

immense concrete tanks, agitated by compressed air to the proper consistency and then pumped to the rotary kilns. This is known as the 'wet' process of cement manufacture, and is the accepted modern method—doing away with all the objectionable dust for which cement mills have long been condemned.

The entire plant is constructed on concrete slabs poured on piles driven from 80 to 85 feet into the ground, and is supposedly earthquake and shock proof.

Transportation is by land and by water. The company has its own deep-water dock, with facilities for handling coastwise and trans-Pacific boats, in Redwood Channel. A spur line of the Southern Pacific Railroad also serves the plant.

The company has its own laboratory with chemical and physical testing apparatus, and the cement manufactured is high grade. It was



used in the building of the San Mateo-San Francisco Bay bridge just opened.

The Pacific Portland Cement Company formerly operated a plant at Cement, Solano County, where in the neighborhood of 500 men were employed. The operating force at the Redwood City plant is about 100 men. Mr. Johnson is superintendent. In 1911 the company opened its present limestone quarry on the American River near Auburn, to supply additional rock for the plant at Cement. It also operates a plaster mill at Gerlach, Nevada, producing gypsum products, and another near El Centro in the Imperial Valley, California.

The capacity of the Redwood City plant is about 5000 barrels a day. Four rotary kilns are in operation. These are from 235 to 250 feet in length and 10 feet in diameter.

#### GOLD AND SILVER

Occasional small veins carrying values in gold have been discovered in San Mateo County, and were described in Report XVII, pp. 172, 173.

Property belonging to the South San Francisco Land and Improvement Co., behind the new high school on the edge of the town of South San Francisco, contained two veins which were discovered and worked by T. V. Barton in the spring and summer of 1919. These were soon abandoned and work has never since been resumed.

#### GRANITE

A rock which has been termed 'Montara granite' by Andrew C. Lawson in the Annual Report of the U. S. Geological Survey, 1893-1894, pp. 405-415, has been quarried on the property of W. C. Irwin of Montara, near the head of Montara Creek, being used to a small extent for building stone, curbing and crushed rock at Montara. This rock has been classed as a quartz-grano-diorite and consists principally of coarse crystals of white feldspar and black hornblende.

#### MAGNESIUM SALTS

*Marine Chemical Company*, R. E. Clark, president, South San Francisco. This company has leased the plant of the Catalytic Chemical Company on the shore of San Francisco Bay, and has operated for two years. Ten men are employed. The principal product is magnesium carbonate, which is precipitated from sea water with lime, purified, passed through an Oliver filter, dried and bagged.

#### PETROLEUM

There has been a small production of petroleum in San Mateo County. The oil is of high gravity, 49°-56° B., and when refined produces about 80% gasoline. It is obtained from sandstone beds, believed to be intercalated with the Monterey shale, a short distance below the base of the Purissima formation.<sup>1</sup>

Bibl: Report X, pp. 586-588; Bulletin 19, pp. 154-156; Bulletin 69, pp. 468-469. U. S. Geol. Survey Geological Folio No. 163.

<sup>1</sup> Geology of the Santa Cruz Quadrangle, U. S. Geol. Survey, Folio No. 163, by J. C. Branner, J. F. Newson and R. Arnold.



*A. & C. Oil Company.* The property is located on the Shore road about two miles south of Half Moon Bay. There is a skeleton derrick and the well is down 2500 feet. No production; apparently abandoned for several years.

*La Honda Oil Fields Association.* Mr. Costello is in charge. This property is located in Sec. 22, T. 7 S., R. 4 W., one-quarter of a mile south of La Honda, on the La Honda-San Gregorio road. Two wells produce irregularly. Oil obtained is refined and sold on the property.

*Midstate Oil Company*, reorganized under the name of *Midstate Consolidated Oil Company*, H. C. Haas, president; T. R. White, secretary; and L. S. Ellis, vice president; home office, Room 667 Mills Building, San Francisco. This company has a checker-board lease with the Shell Oil Company on three ranches—Cowell, Butts and Cowell, located in Secs. 9 and 16, T. 6 S., R. 5 W., and extending a mile and a half south of Purissima Creek on the Shore road, between Half Moon Bay and San Gregorio. There are three flowing wells and a small refinery on the property; the Butts No. 1 well being the most productive. Two men are employed.

*Redwood Petroleum Corporation.* Rollo Ellis of La Honda began drilling in the SE $\frac{1}{4}$  of Sec. 23, T. 7 S., R. 4 W., at a point one mile south of La Honda, some two years ago. He is reported as having sold some stock, but there is no activity at the present time.

*San Mateo Oil and Refining Company.* This company drilled one well to a depth of 300 feet, suspended operations, and has been idle for about two years. The well is located one mile southeast of Half Moon Bay.

*Schwartz*, at Pigeon Point, built a rig, worked but a few days, and only succeeded in burying his tools.

*Sequoia Oil and Gas Company*, a Nevada corporation, is at the present time drilling at the NE. corner of Sec. 19, T. 7 S., R. 4 W., close to the San Gregorio-La Honda road. C. H. McClintock of Half Moon Bay is carrying on drilling operations.

*Shell Oil Company.* The Shell Company drilled one well on Lobitos Creek, about one mile northeast of Lobitos. The well flows several barrels a day, and could be made to produce more by pumping. The Shell Company gave up the well to the Midstate Oil Company. Another well, also turned over to the Midstate people, was drilled by the Shell Company close to the ocean, about a half mile south of Half Moon Bay. This well never produced.

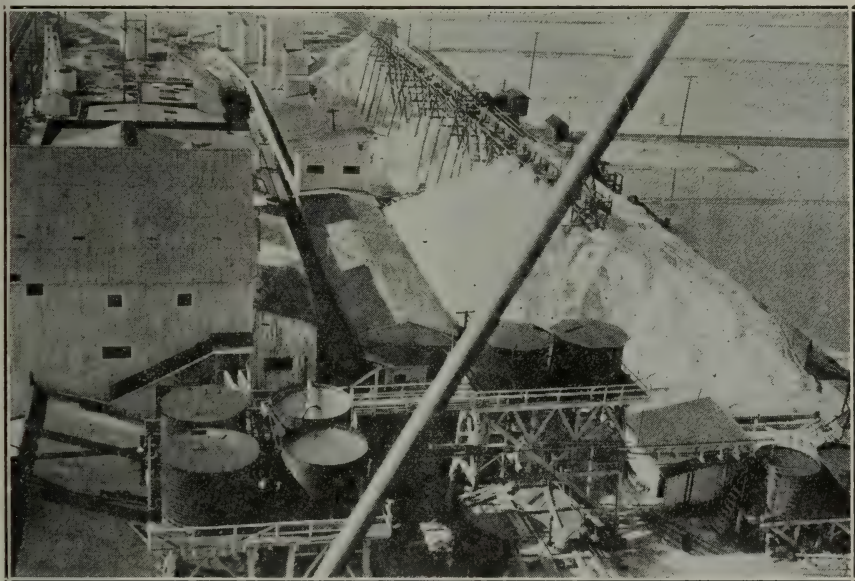
*The Skyline Oil and Refining Corporation* has three producing wells in Purissima Canyon. The fourth well, drilled in 1906, could be made to produce. The oil is of good quality.

There are several derricks near the head of Lobitos Creek, which are said to have been drilled twenty or thirty years ago. No information could be obtained.

#### SALT

*Greco Salt Company.* V. C. Greco, president and manager, Redwood City, California. This company discontinued operations some five or six years ago.

San Mateo plant. *Leslie-California Salt Refining Company*, St. John Whitney, president; L. D. Adams, secretary-treasurer; W. F. Viedevach, vice president; home office, Alexander Building, San Francisco. The plant of this company, located at Leslie, one mile south of San Mateo, covers approximately 1850 acres along the marshes. It was established in 1901 and has operated continuously since. The refinery is on the east side of the Southern Pacific Railroad tracks and the salt ponds stretch out beyond the plant toward the bay. The brine is pumped to large outer ponds, where it is concentrated by solar evaporation and the concentrated brine pumped to smaller ponds closer to the refinery, where the evaporation is completed to dryness. The crude salt covers the ground in depths varying from six inches to one foot. It is shoveled into a train of 1-ton cars which are hauled by gasoline locomotives over



Plant of the Leslie-California Salt Refining Company, showing storage piles of gathered salt.

a light portable track to the factory. Here it is dumped into the conveying and washing machinery, which stacks the salt in a large pile adjoining the refinery. This machine, the whole operation of which is controlled by one man, automatically washes the salt and cleanses it of all surface dirt while it is being piled. This salt is used in the curing of hides, fish, etc., and the manufacture of ice cream. In 1910 the vacuum process for refining the salt was installed. The process is briefly described as follows: The crude salt from the storage pile is redissolved in pure fresh water, and the resultant brine is pumped to settling tanks, where it remains for 24 hours. After leaving the settling tanks the brine is put through an intricate system of sterilization and filtration which removes all impurities. It is then pumped into large pans or evaporators, where the water is boiled away and the salt recrystallized in a pure state. Mechanical rakes then carry the salt to



the dryers, where all moisture is driven out of it. From the dryer it is conveyed to the screens where it is carefully graded and selected for the various uses. The salt for table and kitchen use is sacked by automatic weighing and sewing machines operated by girls. Electric power is used to operate the plant, and crude oil for fuel to supply steam for vacuum pans, driers, etc. An average of 100 men and girls are employed, producing about 25,000 tons yearly. Mr. Kirk is superintendent of the plant.

*Whitney Chemical Company*, subsidiary to the Leslie Salt Refining Company, operates a chemical plant in connection with the salt works. St. John Whitney is president. Magnesium chloride ( $MgCl$ ) crystals are marketed in 200-pound tins under the trade name of 'Whitney Special.' It is used mostly for making magnesite cement, for flooring,



Solar evaporating ponds adjacent to the San Mateo plant of the Leslie-California Salt Refining Company.

etc. Magnesium sulphate ( $MgSO_4$ ) is put up in 4-pound cartons, and is used mostly for salt baths. A 97% potassium chloride is also produced.

*San Francisco Salt Refining Company*, C. de Guine, president; C. Jantsen, secretary; home office, 624 California street, San Francisco. This company operates a salt works, formerly known as the West Shore Salt Company, on the marshes east of Redwood City. The property covers 500 acres. The bay water is evaporated in a series of large vats, and the crystallized salt washed, crushed and stacked. It is marketed without further treatment. Formerly the salt was sent to the company's refinery in San Francisco.



## SAND (MOLDING)

*Industrial Mineral Products, Inc.*, organized and incorporated under the laws of the State of California, June, 1925, was an outgrowth of the Mineral Supply Company with offices in San Francisco, Los Angeles and Chicago. The business of this company has been confined principally to the production and sale of foundry sands.



Two views of the plant of the Industrial Mineral Products, Inc., at South San Francisco. Photos by courtesy of the company.

In 1925 a plant was erected in the city of San Francisco for the production of heavy and medium foundry molding sand. This was the first plant erected and operated on the Pacific Coast where more than one grade of molding sand was milled, blended and screened ready for use

in the foundry. This plant was operated for two years but due to the fact that no deposits of sufficient size were available within the city, where a uniform material could be produced, the plant was wrecked and a new one built on a large deposit in South San Francisco.

The company purchased a suitable plant site and deposit east of the city of South San Francisco on Swift avenue, adjacent to the plant of the Pacific Coast Steel Company, and erected the most modern plant for the production of molding sands in the west. The main mill building contains 1750 square feet of floor space, with two additional buildings for the storage of crude material of 90,000 cubic feet capacity. The storage sheds are constructed in the shape of an L so that three different grades of crude material may be stored and conveyed to a central milling point.

The deposit varies in depth from three to fourteen feet. The upper portion, from four to five feet in depth, is a sand with a light clay content, and carries a high percentage of iron oxide. The next 18 to 20 feet contains as high as 30% refractory colloidal clay. By properly blending these sands a strong refractory sand is produced without lowering the permeability. The material is moved by scraper to a modified Williams hammer mill, is elevated and screened; the oversize is returned to the mill, and the undersize goes to cars or bins on a spur track of the Southern Pacific Railroad. Electric power is used.

The property covers about two acres and the company has rights on an additional thirteen acres. The material is probably a residual erosion deposit.

A laboratory is maintained in connection with the plant where the American Foundrymen's Association standards are used. The sand is blended to take care of any medium or heavy casting job in gray iron, brass or malleable.

This company has examined over seventeen hundred samples of sand located or sent in from various parts of the state and has probably done more to develop the molding sand industry than any other concern in the west. This industry is in its infancy and can be developed only along technical lines by men trained in this branch of engineering.

#### STONE INDUSTRY

Under this heading are grouped crushed rock, sand and gravel. In many localities in the county rock suitable for macadam and concrete work is available. The hard gray metamorphosed sandstone of the Franciscan group is excellent for these uses, and in some localities it has been cut to supply stone for curbing, wall building, etc. Sand is available in great quantities along the many beaches of the west coast.

*Byrnes Stone Quarry*, located on the Spring Valley Water Company's property, near the Mountain House on the Skyline boulevard. This quarry has been operated off and on for fifteen or sixteen years. For the past year it has been leased to J. E. Casey, who has been taking out rock for local road construction. The rock is of blue chert. At the time it was visited it was not being operated, but crushing machinery had not been removed.

*Casey Quarry* (formerly the *Laurel Creek Quarry*). Located at Beresford Station on Laurel Creek. A deposit of decomposed red



chert and buff-colored sandstone was formerly quarried for macadamizing roads in that vicinity. There is no plant at the property, and it has not been worked for several years.

*Daly's Quarry*, owned by the *Market Street Railway Company* of San Francisco, with offices at 58 Sutter street, and operated at intervals by them, is situated on Daly's Hill at San Jose avenue, one-quarter of a mile south of the San Francisco County line. The rock is a close-grained metamorphosed sandstone, light gray in color, and extensively fractured and broken. It is quarried by machine drill and blasting. The broken stone is loaded into 1-cu. yd. cars and hauled by cable over a track to the crushing plant. This is equipped with a No. 5 Gates gyratory crusher, bucket elevator, revolving screens, etc., operated by electric power. The crushed rock is drawn from bins alongside of the railroad track and loaded into electric ballast cars. About 20 men are employed when the quarry is in operation. This quarry has been operated over 15 years by the railroad company, which company uses the entire output. John Murphy is foreman and watchman.

Bibl: Bull. 38, p. 323.

*Gardner Quarry*, operated by the *San Mateo Feed and Fuel Co.*, and owned by the *San Francisco Bay Terminal Co.* The quarry is about one-half miles east of Belmont, and is idle at the present time, although some 30,000 yards of 'red rock' have been taken out in the past year for local road construction.

Bibl: Bull. 38, p. 323.

*Golden West Quarry* is owned and operated by *Ratterree Brothers Company*, 400 Walbridge avenue, San Francisco, and is located about one-half mile northwest of the Southern Pacific car shops at Visitacion, just across the San Francisco-San Mateo County line. It has been operating for about five years. Six men are employed. The rock is a blue chert. Crushing machinery consists of a gyratory crusher and a No. 3 Symons.

*Hilderbrandt's Quarry* is located in the center of Sec. 14, T. 7 S., R. 4 W., a quarter of a mile northeast of La Honda, on the Woodside-La Honda road. It has not been operated since October, 1928, when it was used as a source of supply of red sandstone by the county for local road construction; some 14,300 yards having been removed.

*Holt's Quarries* are three in number. The first two are located a few hundred yards apart,  $1\frac{1}{2}$  miles from Woodside on the Canada road, between Woodside and Crystal Springs Lake. The third is two miles from Redwood City on the Redwood City-Crystal Springs road. They are operated by Leonard and Holt, realtors of San Francisco and San Mateo. Mr. McCormick is superintendent. The company's offices are in the Administration Building at Emerald Lake in Redwood City. The rock is a blue-gray close-grained metamorphosed sandstone, at the latter quarry, while at the first two mentioned it is the characteristic 'red rock.' No crusher is used. The rock is sufficiently shattered in quarrying operations so that it needs only to be screened. It is used for local road construction.



*Mission Quarry*, located on the county line, a quarter of a mile north of the Golden West Quarry, is owned and operated by the Mission Quarry Company, 210 Balboa Building, Second and Market streets, San Francisco. It was originally owned by the Market Street Railway Company, and was operated for 15 years by them. Mr. Manson is superintendent. From 11 to 14 men are employed. A description of the quarry is given in the San Francisco County report, elsewhere in this issue.

*Pilarcitos Sand Plant.*

Bibl: Report XVII, p. 177.

*Rockaway Quarry.*

Bibl: Report XVII, p. 177.

*San Mateo Development Company*; John E. Casey, president; H. E. Casey, manager; D. J. Stollery, secretary; home office, Third and B streets, San Mateo. This company, organized in 1907, operates a quarry on the Half Moon Bay road about two miles west of San Mateo. The rock is the close-grained metamorphosed sandstone, gray in color, characteristic of the Franciscan group. Quarries have been opened at two localities along the road one-half mile apart. The upper quarry is now being worked, the lower quarry being used only for storage of crushed rock. The crushing machinery has recently been moved from the lower to the upper quarry, and consists of a No. 6 and a No. 4 gyratory crusher, bucket elevators, revolving screens, with one 50-h.p. motor and one 30-h.p. motor to operate the plant. The rock is used for macadamizing and for concrete work. Occasionally large blocks are cut for curbing or wall building. About 25 men are employed at the quarry and at the company's yards in Burlingame.

*Splivano and Johnson Quarry.*

Bibl: Report XVII, p. 179; Bull. 38, p. 323.

*Vasquez Quarry.*

Bibl: Report XVII, p. 179.

*San Mateo County* has used some 5000 yards of red sandstone for road construction in the northern part of the county. This has been taken at intervals from several small quarries; the first of which is located on the Skyline boulevard a mile and a half south of Lawndale; the second on the Salada Beach road, one-half mile southwest of its junction with the Skyline boulevard; the third is at the junction of the San Bruno-Rockaway Beach road with the Skyline boulevard; the fourth on the Mills estate, one-half mile west of San Bruno on the San Bruno-San Andreas Lake road; the fifth and sixth are on Spring Valley property between San Andreas Lake and the Skyline boulevard, one at the north end of the lake and one near the south end.

In addition to the above mentioned 5000 yards of material, a great deal more has been utilized from 'cut' to make 'fill' in the construction of the new Bayshore Highway between San Francisco and South San Francisco.

At Pebble Beach, near Pescadero, the county installed a crusher and began taking out red chert on April 23d, for use on local roads. The quarry is located at the water's edge. The crusher is a No. 4 gyratory, and is supplemented by a revolving screen and a small gasoline-operated fine crusher.

### LOS ANGELES FIELD DIVISION

W. BURLING, TUCKER, Mining Engineer.

On account of unfinished field work, there is no report from the Los Angeles Field Division in this issue.



## OIL FIELD DEVELOPMENT OPERATIONS

By R. D. BUSH, State Oil and Gas Supervisor

From January 1, 1929, to and including March 31, 1929, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
<b>FRESNO COUNTY:</b>					
Paragon Oil Co.....	17	19	15	19	Coalunga
Section Thirty Oil Co.....	30	19	15	1	Coalunga
Milham Exploration Co.....	28	21	17	Kennedy 1	Kettleman Hills
Pacific Western Oil Co.....	12	22	17	54	Kettleman Hills
Petroleum Securities Co.....	35	21	17	Felix 1	Kettleman Hills
W. E. Hornaday & E. F. Huggins.....	32	14	18	1	-----
Thomas Petroleum Corp.....	33	22	16	1	-----
<b>IMPERIAL COUNTY:</b>					
Imperial Valley Petroleum Co.....	33	11	10	1	-----
<b>KERN COUNTY:</b>					
Berry Oil Co.....	30	28	21	92	Belridge
Berry Oil Co.....	30	28	21	96	Belridge
Berry Oil Co.....	30	28	21	97	Belridge
Berry Oil Co.....	30	28	21	101	Belridge
The Ohio Oil Co.....	30	28	21	23	Belridge
The Ohio Oil Co.....	30	28	21	24	Belridge
Union Oil Co.....	30	28	21	King 8	Belridge
Union Oil Co.....	30	28	21	King 9	Belridge
Union Oil Co.....	30	28	21	King 10	Belridge
Union Oil Co.....	30	28	21	King 11	Belridge
Milham Exploration Co.....	8	28	23	Harris 1	Buttonwillow Gas
Southern California Gas Co.....	27	28	23	1	Buttonwillow Gas
General Petroleum Corp.....	22	29	27	Hensley 3	Fruitvale
Mohawk Petroleum Co.....	27	29	27	3	Fruitvale
The Pacific Eastern Production Co.....	22	29	27	8-KCL-B	Fruitvale
The Pacific Eastern Production Co.....	26	29	27	1-KCL-D	Fruitvale
The Pacific Eastern Production Co.....	28	29	27	1-KCL-C	Fruitvale
H. H. Bell.....	6	28	28	2	Kern River
C. C. M. O. Co.....	23	28	27	22	Kern River
C. C. M. O. Co.....	23	28	27	23	Kern River
The Ohio Oil Co.....	32	27	27	1	Kern River
Pan American Petroleum Co.....	22	28	27	5	Kern River
Pan American Petroleum Co.....	22	28	27	10	Kern River
Pan American Petroleum Co.....	22	28	27	25	Kern River
Pan American Petroleum Co.....	22	28	27	30	Kern River
Richfield Oil Co.....	20	28	28	Boston 1	Kern River
Fred M. Sayre.....	8	28	28	Sayre-McNeil 3	Kern River
Cymric Oil Co.....	26	29	21	6	McKittrick
The Texas Co.....	4	30	22	Aldridge 1	McKittrick
C. C. M. O. Co.....	7	32	23	6	Midway
Honolulu Consolidated Oil Co.....	8	32	24	11	Midway
Honolulu Consolidated Oil Co.....	8	32	24	83	Midway
Honolulu Consolidated Oil Co.....	8	32	24	85	Midway
John Knudsen.....	12	32	22	Eddie Schmidt 1	Midway
Lincoln Drilling Co.....	18	32	23	1	Midway
North American Oil Consolidated.....	30	31	24	37	Midway
North American Oil Consolidated.....	30	31	24	38	Midway
North American Oil Consolidated.....	32	31	24	20	Midway
North American Oil Consolidated.....	32	31	24	23	Midway
North American Oil Consolidated.....	32	31	24	24	Midway
North American Oil Consolidated.....	2	32	23	22	Midway
North American Oil Consolidated.....	2	32	23	23	Midway
The Ohio Oil Co.....	9	31	22	1	Midway
Republic Petroleum Co.....	7	32	23	34	Midway
Shell Oil Co.....	15	32	23	Perris A-1	Midway
Standard Oil Co.....	29	31	24	15	Midway
Standard Oil Co.....	29	31	24	16	Midway
Standard Oil Co.....	1	32	23	2	Midway
Standard Oil Co.....	1	32	23	4	Midway



## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>KERN COUNTY—Continued</b>					
Standard Oil Co.....	1	32	23	5	Midway
Standard Oil Co.....	26	32	23	Mascot 1	Midway
Standard Oil Co.....	7	32	24	60	Midway
Standard Oil Co.....	9	32	24	4	Midway
Standard Oil Co.....	9	32	24	5	Midway
Standard Oil Co.....	9	32	24	6	Midway
R. T. Dennis.....	32	26	28	4	Mt. Poso
General Petroleum Corp.....	21	27	28	Glide 21 24	Mt. Poso
General Petroleum Corp.....	21	27	28	Glide 21	Mt. Poso
General Petroleum Corp.....	16	27	28	Heisen 11	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 9	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 10	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 11	Mt. Poso
Shell Oil Co.....	15	27	28	Glide 1	Mt. Poso
Signal Oil & Gas Co.....	27	27	28	5	Mt. Poso
Signal Oil & Gas Co.....	27	27	28	6	Mt. Poso
Superior Oil Co.....	27	27	28	Glide 27 1	Mt. Poso
Noble H. Wible.....	32	26	28	Wible 1	Mt. Poso
Elbe Oil Land Development Co.....	20	28	29	Freeman 3	Round Mountain
Shell Oil Co.....	29	28	29	Jewett 5	Round Mountain
Union Oil Co.....	10	11	23	Houchin 4	Sunset
Dollar Oil Co.....	18	31	22	Haberkern 1	-----
Dollar Oil Co.....	18	31	22	Z. L. Phelps 1	-----
The Elmer Co.....	33	29	26	1	-----
The Elmer Co.....	15	30	30	1	-----
George F. Getty, Inc.....	29	31	22	Phelps 1	-----
Mineral Mountain Mining Co.....	7	27	19	1	-----
Shell Oil Co.....	21	26	28	Rodgers-Jones 1	-----
Union Oil Co.....	5	10	21	KCLC 2	-----
<b>KINGS COUNTY:</b>					
Bolsa Chica Oil Corp.....	24	22	17	Ferguson 1	Kettleman Hills
General Petroleum Corp.....	20	22	18	2	Kettleman Hills
Marland Oil Co.....	2	22	17	2-13	Kettleman Hills
Marland Oil Co.....	12	22	17	12-8	Kettleman Hills
The Ohio Oil Co.....	35	24	19	1	Kettleman Hills
Pacific Western Oil Co.....	34	21	17	27	Kettleman Hills
Shell Oil Co.....	8	22	18	Armstrong 1	Kettleman Hills
Standard Oil Co.....	1	22	17	8	Kettleman Hills
Standard Oil Co.....	3	22	17	41	Kettleman Hills
Standard Oil Co.....	11	22	7	61	Kettleman Hills
Standard Oil Co.....	7	22	18	78	Kettleman Hills
Standard Oil Co.....	27	22	18	87	Kettleman Hills
Standard Oil Co.....	10	22	17	Armstrong 81	Kettleman Hills
<b>LOS ANGELES COUNTY:</b>					
Standard Oil Co.....	17	2	14	L. A. Investment 1-59	Inglewood
Barnsdall Oil Co.....	16	3	14	Bonney-	-----
Coast Line Oil Co., Ltd.....	21	2	14	Wright 1	Lawndale
Continental Oil Co.....	17	3	14	Taylor 1	Lawndale
Continental Oil Co.....	21	3	14	Alexander 1	Lawndale
J. M. Cummins.....	21	3	14	Phoel 1	Lawndale
Earl Petroleum Corp., Ltd.....	21	3	14	Holcomb 1	Lawndale
The Elmer Co.....	16	3	14	Sprott 1	Lawndale
Ethyl Oil Co.....	17	3	14	Elmer 1	Lawndale
General Petroleum Corp.....	17	3	14	1	Lawndale
George F. Getty, Inc.....	17	3	14	Johnson 1	Lawndale
George F. Getty, Inc.....	21	3	14	L 1	Lawndale
Globe Lease & Royalty Co.....	21	3	14	L 2	Lawndale
Golconda Petroleum Corp.....	16	3	14	Jones 5	Lawndale
Hall Petroleum Corp.....	21	3	14	1	Lawndale
Boyd Hammond, Trustee.....	17	3	14	9	Lawndale
Hancock Oil Co.....	21	3	14	1	Lawndale
Hancock Oil Co.....	21	3	14	Lawndale 1	Lawndale
Italo Petroleum Corp. of America.....	16	3	14	Lawndale 2	Lawndale
Jimco Oil Co.....	21	3	14	Fried 1	Lawndale
Thomas B. Leddy.....	21	3	14	Dale 1	Lawndale
				1	Lawndale

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
John W. Leonard & L. Restrepo.....	21	3	14	1	Lawndale
Sam N. Lewis.....	21	3	14	6	Lawndale
M. L. C. R. Co.....	17	3	14	Question Mark 1	Lawndale
McKeon Drilling Co., Inc.....	17	3	14	Fee 1	Lawndale
J. E. O'Donnell.....	21	3	14	70	Lawndale
Pacific Western Oil Co.....	21	3	14	Harvey-Smith 1	Lawndale
Pacific Western Oil Co.....	20	3	14	Howland 1	Lawndale
Pacific Western Oil Co.....	20	3	14	Howland 2	Lawndale
Petroleum Securities Co.....	21	3	14	Brown 1	Lawndale
Petroleum Securities Co.....	21	3	14	Brown 2	Lawndale
Richfield Consolidated Oil Co.....	16	3	14	Footo 1	Lawndale
Richfield Oil Co.....	20	3	14	Paul Howard 1	Lawndale
Richfield Oil Co.....	17	3	14	Intercity 1	Lawndale
Richfield Oil Co.....	7	3	14	Woods 1	Lawndale
San Clemente Oil Co.....	20	3	14	Peck 2	Lawndale
Shell Oil Co.....	17	3	14	Barkdall 1	Lawndale
Shell Oil Co.....	21	3	14	Ozenne 1	Lawndale
Shell Oil Co.....	20	3	14	Peck 1	Lawndale
Shell Oil Co.....	17	3	14	Harvey Smith 1	Lawndale
Shell Oil Co.....	17	3	14	Smith	
Smith Development Co.....	20	3	14	Community 1	Lawndale
Smith Development Co.....	20	3	14	2	Lawndale
Smith Development Co.....	20	3	14	3	Lawndale
Smith Petroleum Co.....	17	3	14	4	Lawndale
Sovereign Oil Corp.....	21	3	14	2	Lawndale
The St. Helens Petroleum Co., Ltd.....	21	3	14	5	Lawndale
Standard Oil Co.....	17	3	14	Smith 1	Lawndale
Standard Oil Co.....	21	3	14	Thomas 1	Lawndale
Standard Oil Co.....	16	3	14	Vance 1	Lawndale
Superior Oil Co.....	8	3	14	Ritter 1	Lawndale
Superior Oil Co.....	21	3	14	Security 1	Lawndale
Transpacific Oil Corp.....	17	3	14	Jameson Estle 1	Lawndale
Union Oil Co.....	16	3	14	Johnson 1	Lawndale
Union Oil Co.....	16	3	14	Root 1	Lawndale
Union Oil Co.....	16	3	14	Root 2	Lawndale
"We" Syndicate.....	16	3	14	2	Lawndale
West American Oil Co.....	16	3	14	Pan Cal 1	Lawndale
West Coast Petroleum Combinations, Inc.....	21	3	14	1	Lawndale
Western Drilling & Producing Co.....	17	3	14	C. O. P. 1	Lawndale
Western Oil & Refining Co.....	21	3	14	Crowley 1	Lawndale
Allen Brown.....	19	4	12	James 1	Long Beach
Cal-Mex Oil & Refining Co.....	19	4	12	25	Long Beach
Cannon-Jones Oil Co.....	29	4	12	Hall-Webber 2	Long Beach
Continental Oil Co.....	24	4	13	Denio 2	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	27	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	28	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	29	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	30	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	31	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	32	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	33	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	34	Long Beach
Dabney-Johnston Oil Corp.....	13	4	13	35	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	36	Long Beach
Graham-Loftus Oil Corp.....	24	4	13	American 1	Long Beach
Graham-Loftus Oil Corp.....	24	4	13	Rodgers 1	Long Beach
Italo Petroleum Corp. of America.....	19	4	12	Acme 4	Long Beach
A. T. Jergins Syn.....	30	4	12	4-A	Long Beach
MacMillan Petroleum Corp.....	24	4	13	7	Long Beach
MacMillan Petroleum Corp.....	24	4	13	8	Long Beach
MacMillan Petroleum Corp.....	24	4	13	9	Long Beach
The Petroleum Co.....	24	4	13	Security 2	Long Beach
The Petroleum Co.....	24	4	13	Wellman 2	Long Beach
Max Pray.....	29	4	12	3	Long Beach
J. Orville Seepie.....	19	4	12	Seepie 6	Long Beach
Shell Oil Co.....	29	4	12	Brown 2	Long Beach
Shell Oil Co.....	29	4	12	Nesa 12	Long Beach
Shell Oil Co.....	29	4	12	Patton-Wilson 9	Long Beach

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Western Oil & Refining Co.-----	24	4	13	Liebert Comm. 1	Long Beach
Western Oil & Refining Co.-----	19	4	12	Pooler Comm. 1	Long Beach
Western Oil & Refining Co. and Olympic Refining Co.-----	19	4	12	15	Long Beach
P. B. Anderson-----	1	3	16		Newhall
Pico Dome Oil & Gas Co.-----	14	3	16		Newhall
Associated Oil Co.-----	34	2	14	Potrero 1	Potrero
Max Pray-----	28	2	14		Potrero
John A. Woodward, Jr.-----	28	2	14	Thornton 1	Potrero
Barnsdall Oil Co.-----	18	3	13	O'Dea 3-A	Rosecrans
Barnsdall Oil Co.-----	20	3	13	Rosecrans 5-A	Rosecrans
Burlingham Petroleum Corp.-----	17	3	13		Rosecrans
Richfield Oil Co.-----	20	3	13	Rosecrans 2	Rosecrans
Union Oil Co.-----	18	3	13	Rosecrans 12	Rosecrans
Bandini Petroleum Co.-----	5	3	11	Off 12	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 13	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 14	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 15	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 16	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 17	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 18	Santa Fe Springs
Bandini Petroleum Co.-----	5	3	11	Off 19	Santa Fe Springs
Bell View Oil Syn.-----	6	3	11	Santa Fe 3	Santa Fe Springs
L. E. Bishop-----	5	3	11		Santa Fe Springs
Commodore Petroleum Co.-----	5	3	11	Babonet 4	Santa Fe Springs
Commodore Petroleum Co.-----	5	3	11	Babonet 5	Santa Fe Springs
Commodore Petroleum Co.-----	5	3	11	Landl 4	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Anderson 153-D	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Anderson 153-E	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Hill 187-C	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Hill Midway 104	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 129	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 136	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 143	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 146	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 152-F	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 152-G	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	E. G. B. 101-C	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 160-B	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 160-C	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 161-B	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 168-D	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 205	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 217	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 218	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 220	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 222	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 224	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 230	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 232	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 233	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 234	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 235	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Santa Fe	
General Petroleum Corp.-----	6	3	11	Comm. 177-D	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Santa Fe	
General Petroleum Corp.-----	6	3	11	Comm. 191-D	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Santa Fe	
General Petroleum Corp.-----	6	3	11	Comm. 191-E	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Santa Fe	
General Petroleum Corp.-----	6	3	11	Comm. 179-F	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Santa Fe	
General Petroleum Corp.-----	6	3	11	Comm. 179-G	Santa Fe Springs
General Petroleum Corp.-----	6	3	11	Santa Fe	
General Petroleum Corp.-----	6	3	11	Comm. 186-G	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 20-A	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 29	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 30	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 31	Santa Fe Springs



## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>LOS ANGELES COUNTY—Cont.</b>					
George F. Getty, Inc.-----	5	3	11	S. F. S. 32	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 33	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 34	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 35	Santa Fe Springs
George F. Getty, Inc.-----	5	3	11	S. F. S. 36	Santa Fe Springs
Illuminating Petroleum Well No. 1..	5	3	11	1	Santa Fe Springs
McKeon Drilling Co., Inc.-----	6	3	11	Santa Fe 4	Santa Fe Springs
Earl Moore-----	5	3	11	1	Santa Fe Springs
Richfield Oil Co.-----	5	3	11	Howard 4	Santa Fe Springs
Second Twin Bell Syn.-----	6	3	11	6	Santa Fe Springs
Standard Oil Co.-----	5	3	11	S. Whittier Comm. 23	Santa Fe Springs
Standard Oil Co.-----	5	3	11	S. Whittier Comm. 24	Santa Fe Springs
Standard Oil Co.-----	5	3	11	S. Whittier Comm. 25	Santa Fe Springs
Standard Oil Co.-----	5	3	11	S. Whittier Comm. 26	Santa Fe Springs
Standard Oil Co.-----	5	3	11	S. Whittier Comm. 27	Santa Fe Springs
Superior Oil Co.-----	6	3	11	Wardman 6	Santa Fe Springs
Superior Oil Co.-----	6	3	11	Wardman 7	Santa Fe Springs
The Texas Co.-----	6	3	11	Weaver 7	Santa Fe Springs
Third Twin Bell Synd.-----	6	3	11	1	Santa Fe Springs
Third Twin Bell Synd.-----	6	3	11	2	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 43	Santa Fe Springs
Union Oil Co.-----	31	2	11	Bell 44	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 45	Santa Fe Springs
Union Oil Co.-----	31	2	11	Bell 46	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 47	Santa Fe Springs
Union Oil Co.-----	5	3	11	Farwell 12	Santa Fe Springs
Union Oil Co.-----	5	3	11	Farwell 13	Santa Fe Springs
Union Oil Co.-----	5	3	11	Farwell 14	Santa Fe Springs
Union Oil Co.-----	5	3	11	Farwell 15	Santa Fe Springs
Union Oil Co.-----	5	3	11	Farwell 17	Santa Fe Springs
Union Oil Co.-----	31	2	11	Howard 12	Santa Fe Springs
Union Oil Co.-----	31	2	11	Howard 13	Santa Fe Springs
Wilshire Oil Co., Inc.-----	6	3	11	Wilshire- Baker 4-A	Santa Fe Springs
York-Smullin Oil Co.-----	5	3	11	Wickman 4	Santa Fe Springs
York-Smullin Oil Co.-----	5	3	11	Wickman 5	Santa Fe Springs
Marland Oil Co.-----	11	5	12	Bixby 20	Seal Beach
Standard Oil Co.-----	11	5	12	San Gabriel 20	Seal Beach
Standard Oil Co.-----	3	5	12	San Gabriel 21	Seal Beach
Standard Oil Co.-----	11	5	12	San Gabriel 22	Seal Beach
Petroleum Securities Co.-----	32	3	14	Schwuchow 1	Torrance
Roy M. Christenson-----	34	6	11	1	Torrance
Coast Line Oil Co., Ltd.-----	21	5	17	1	Torrance
R. W. Jackson-----	19	2	11	Florey Comm. 1	-----
Mohawk Petroleum Co.-----	29	3	14	Towell 1	Torrance
The Ohio Oil Co.-----	22	2	15	1	Torrance
Petroleo Syn.-----	33	4	12	1	-----
Pugh-Miller Drilling Co.-----	6	1	17	1	-----
Union Oil Co.-----	16	3	14	Higbie 1	-----
Western Drilling & Producing Co.---	30	3	14	Carlin-Smith 1	Torrance
<b>MERCED COUNTY:</b>					
Henry L. Kuns-----	8	12	9	3	-----
<b>MONTEREY COUNTY:</b>					
Shell Oil Co.-----	15	22	9	Dudley 1	-----
<b>ORANGE COUNTY:</b>					
Standard Oil Co.-----	13	3	11	Emery 43	Coyote Hills
Standard Oil Co.-----	24	3	11	Emery 44	Coyote Hills
Standard Oil Co.-----	13	3	11	Emery 45	Coyote Hills
Richfield Oil Co.-----	2	6	11	Bardeen 1	Huntington Beach
West Coast Petroleum Combina- tions, Inc.-----	2	6	11	2	Huntington Beach

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
Western Drilling & Producing Co. ....	10	6	11	25	Huntington Beach
V. R. G. Wilbur .....	2	6	11	Mosier 1	Huntington Beach
Continental Oil Co. ....	33	3	9	Richfield	
Continental Oil Co. ....	33	3	9	Comm. 3	Richfield
Continental Oil Co. ....	33	3	9	Santa Fe 1	Richfield
Continental Oil Co. ....	33	3	9	Winann 2	Richfield
George W. Johnson .....	27	3	9	Stein 1	Richfield
Rawco, Inc. ....	33	3	9	Rawco 2	Richfield
Southwestern Oil Co. ....	21	3	9	Yorba	
Superior Oil Co. ....	33	3	9	Linda-Day 1	Richfield
Superior Oil Co. ....	33	3	9	Etchandy 3	Richfield
Valencia Syn. ....	28	3	9	Richfield Fee 1	Richfield
Valencia Syn. ....	28	3	9	1	Richfield
Western Drilling & Producing Co. ....	18	6	10	Meyer 1	-----
SAN LUIS OBISPO COUNTY:					
L. W. Bering & Associates .....	13	32	22	1	-----
Western Drilling & Producing Co. ....	2	32	22	Dollar 1	-----
SANTA BARBARA COUNTY:					
Barnsdall Oil Co. ....	22	4	29	Doty 3	Elwood
Barnsdall Oil Co. ....	23	4	29	Doty 4	Elwood
Barnsdall Oil Co. ....	15	4	29	Luton-Bell 6	Elwood
R. Hector McIntosh .....	24	4	29	Scott-	
Padre Oil Co. ....		4	29	McIntosh 1	Elwood
F. G. Anderson, Trustee .....		4	28	1	Goleta
Chanel Oil & Development Co. ....		4	27	Fellowship 1	Goleta
Exeter Oil Co. ....		4	28	1	-----
Olympic Refining Co. ....		4	27	Lomas 1	-----
Shell Oil Co. ....	25	10	35	Union Sugar A-1	-----
Shell Oil Co. ....	36	10	35	Union Sugar A-2	-----
Standard Oil Co. ....		4	34	Gerber 1	-----
System Oil Co. ....	36	10	34	1	-----
VENTURA COUNTY:					
The Texas Co. ....	2	3	19	McGuire 1	Bardsdale
Bolsa Chica Oil Corp. ....	4	4	18	Snow 1	Piru
C. C. M. O. Co. ....	8	3	24	Hobson B-4	Rincon
C. C. M. O. Co. ....	17	3	24	Hobson B-7	Rincon
General Petroleum Corp. ....	8	3	24	Tomson 3	Rincon
Empire Oil Co. ....	13	4	21		Santa Paula
Frank Oil Co. ....	35	4	20	1	Sespe
Metro Grande Oil Co. ....	1	4	20	10	Sespe
Metro Grande Oil Co. ....	1	4	20	11	Sespe
E. A. Parkford .....	6	2	17	1	Simi
E. A. Parkford .....	6	2	17	2	Simi
F. A. Craise .....	17	3	20	Schieferle 1	South Mountain
The Texas Co. ....	13	3	21	Harvey 25	South Mountain
Associated Oil Co. ....	27	3	23	Lloyd 53	Ventura
Associated Oil Co. ....	27	3	23	Lloyd 58	Ventura
Associated Oil Co. ....	27	3	23	Lloyd 72	Ventura
Associated Oil Co. ....	27	3	23	Lloyd 73	Ventura
Pacific Western Oil Co. ....	28	3	23	Orton 14	Ventura
Pacific Western Oil Co. ....	28	3	23	S. P. Willett 1	Ventura
Pacific Western Oil Co. ....	28	3	23	Willett 6	Ventura
Petroleum Securities Co. ....	22	3	23	Hartman 1	Ventura
Shell Oil Co. ....	27	3	23	Gosnell 33	Ventura
Shell Oil Co. ....	29	3	23	Taylor 34	Ventura
Shell Oil Co. ....	28	3	23	Taylor 36	Ventura
Shell Oil Co. ....	28	3	23	Taylor 37	Ventura
Shell Oil Co. ....	28	3	23	Taylor 38	Ventura
Shell Oil Co. ....	28	3	23	Taylor 40	Ventura
Shell Oil Co. ....	28	3	23	Taylor 41	Ventura
Shell Oil Co. ....	21	3	23	Taylor-Lloyd 1	Ventura
Lockwood Valley Oil Co. ....	28	8	21	1	-----
The Texas Co. ....	23	1	22	Eastwood 1	-----

## ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

**Personnel.**

There have been no changes of personnel to be noted, during the past three months.

**New Publications.**

During the quarterly period covered by this issue, the following publications of the Division of Mines and Mining have been made available for distribution:

Mining in California (quarterly), October, 1928, and January, 1929, being Chapter 4 of State Mineralogist's Report XXIV, and Chapter 1 of Report XXV. Price 25 cents each. The October issue contains reports on the Mineral Resources of Plumas and Madera counties, and the Biennial Report of the State Mineralogist. The January issue contains reports on the Mineral Resources of Lassen, Modoc and Kern counties; also the following special articles: "Mammoth Tusks found near Oroville, Cal."; "Mineral Pigment Tests"; "American Manganese Producers Association"; "Some Special Methods and Machines for Recovery of Gold and Platinum in Placer Deposits."

Summary of Operations, California Oil Fields, Vol. 13, No. 12; Vol. 14, No. 1, June and July, 1928, respectively, containing the following special articles: (June) "Tar Sands in the Town-lot Area of Huntington Beach Oil Field"; (July) "Miocene Formations in the East Side Fields of Kern County."

Commercial Mineral Notes, Nos. 70, 71, 72, January, February, March, 1929, respectively. These 'notes' contain the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet, monthly. It is mailed free to those on the mailing list for MINING IN CALIFORNIA.

**Mails and Files.**

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.





## MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

## STATISTICS

California continues to produce commercially, as for some years past, more than 50 different mineral substances, the total value of which for 1928 was estimated at \$353,444,500 (see January issue of *Mining in California*, page 137).

At the present writing (April 1st) reports are in hand for most of the producers. Data for several substances are now complete and have been compiled, being presented herewith.

Information at hand indicates that there was no production in California during 1928 of the following substances, which have at one time or another in the past been on the active list here: arsenic, bismuth, fluorspar, graphite, mica, molybdenum, serpentine, sulphur, strontium. There was production by a single operator in each of the following: bromine, cyanite, lithia, manganese ore, mineral paint, potash, tin, titanium, the figures for which will have to be combined under the 'unapportioned' item in the final report. A production of tin was reported this year, which is the first since 1892.

## ANTIMONY

During 1928 in California there was mined and sold a total of 70 tons of antimony ore calculated to 45% antimony valued at \$2761 by 4 producers, one in Kern County and three in San Bernardino County. The Kern County ore ran from 28% to 39% antimony and the San Bernardino shipments from 40% to 79% antimony. There now is a smelter in Los Angeles handling antimony ore and most of the California producers ship their ore there for treatment.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper). An alloy of 6% antimony and 94% lead is being extensively used in making battery plates for storage batteries for automobiles, airplanes, and radio apparatus.

## BITUMINOUS ROCK

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent, probably the residue from the evaporation of a crude petroleum deposit. Bituminous rock is still used to a limited extent for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost entirely superseded the direct use of the native material. Some of the Santa Cruz County production is put on the market as a material which can be laid cold. This material is especially applicable and valuable for patch jobs.

Shipments from quarries in Santa Barbara and Santa Cruz counties in 1928 totaled 5,966 tons of bituminous rock valued at \$33,832 rail

shipping point. This was an increase both in quantity and value over the 1927 production which was 3,515 tons and \$17,704.

#### CEMENT

Cement is the most important single structural material in the mineral output of California. During 1928 there was a total of 13,625,231 barrels valued at \$24,463,287 f.o.b. plant, being a decrease in both quantity and value. The 1927 output was 14,661,783 barrels valued at \$26,474,935 or an average of \$1.80 per barrel. The 1928 average value was \$1.79 per barrel.

The 1928 production came from eleven operating plants in nine counties and employing a total of 2,088 men. Three plants in San Bernardino County made a total of 4,383,383 barrels valued at \$7,137,606, the balance of the state's production coming from a single plant in each of the following counties: Calaveras, Contra Costa, Kern, Merced, Riverside, San Benito, San Mateo, and Santa Cruz.

#### COAL

Coal produced in California in 1928 totaled 582 short tons valued at \$3,442, coming from a single producer in each of the following counties: Amador, Contra Costa, and Shasta. This was an increase over 1927 output. That coming from Amador and Contra Costa Counties was sold in local markets for domestic use or utilized on the property for camp purposes, power and forge, to carry on regular operation and development work; while that from Shasta County was shipped to the gas works in Marysville where it was tested for manufacture of gas.

#### PYRITE

A total production of 90,566 tons of pyrite valued at \$400,627 was reported shipped in California during 1928, from properties in Alameda, San Benito and Shasta counties. This was a decrease both in quantity and value over 1927 figures which were 130,910 tons and \$564,823.

The material shipped had a sulphur content ranging up to 46.5% S. It is mostly used in the manufacture of sulphuric acid for explosives and fertilizers, though a portion is utilized directly in the preparation of agricultural fertilizers and insecticides. The material from San Benito County was an iron sulphate (not an iron sulphide) but was used in the manufacture of fertilizer and insecticide, the same as some of the pyrite and therefore grouped with pyrite.

This does not include the large quantities of pyrite, chalcopyrite and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

#### SALT

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach.

Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Inyo, Kern and San Bernardino counties, and evaporation of alkaline lake water in Modoc County. A small amount of valuable medical salts is obtained by evaporation of the water of Lake Mono, Mono County.

Distribution of the 1928 salt production of California, by counties, was as follows:

<i>County</i>	<i>Tons</i>	<i>Value</i>
Alameda -----	224,000	\$611,888
Kern -----	8,032	40,160
San Bernardino -----	42,244	186,470
Inyo, Los Angeles, Modoc, Mono, <sup>a</sup> Monterey, San Diego, San Mateo <sup>b</sup> -----	66,304	186,138
Totals -----	340,580	\$1,024,656

<sup>a</sup> Medicinal salts.

<sup>b</sup> Combined to conceal output of a single operator in each.

The above results show an increase in both tonnage and value over the 1927 figures which were 263,028 tons and \$639,127. There were fifteen plants operating in 1928, four of which were in Alameda County.

#### SLATE

In California there were shipments in 1928 amounting to 4,075 tons valued at \$31,263 coming from El Dorado, Riverside and Tuolumne counties. This was an increase in both quantity and value over the 1927 output which was 2,686 tons and \$17,960. Most of this slate was crushed and used for roofing granules, although a small portion was used as flagging.

#### SOAPSTONE AND TALC

The total output of talc and soapstone in California in 1928 amounted to 18,668 tons valued at \$251,372, an increase over the 1927 output which was 16,218 tons and \$164,744. Over 80 per cent of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized, mainly in toilet powders, paint, paper and rubber manufacture, and some in ceramics. The remainder came from Butte, Calaveras and El Dorado counties, being soapstone, with some of the El Dorado material, a steatite variety used in making electrical insulators. El Dorado and Inyo have three producers each, Butte two producers, Calaveras and San Bernardino a single producer each.

The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc has to some extent at least replaced imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

#### MUSEUM

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the five first of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.



Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

## LABORATORY

FRANK SANBORN, Mineral Technologist

The correct answers to the queries, What is it? and Has it any value?—questions concerning minerals sometimes incited by mere curiosity, but more often originating with those who have been pioneers in building up the mining industry of the state, have been the initial step in much of the development recorded in the past forty years. The State Division of Mines and Mining, since it was first organized as the State Mining Bureau, has supplied the necessary answer in thousands of cases without cost to the individual; and has been largely instrumental in bringing to light the minerals of both scientific interest and practical utility found in California.

Few may fail to recognize the native yellow metal, but gold now falls far short of being the premier mineral product. On the contrary, cement, one of the most unobtrusive appearing products, has exceeded gold in the value of its yearly output since 1920, as has petroleum for more than a decade.

The rapid increase in the number of structural and industrial minerals and salines, whose character, use and value are seldom recognized without the aid of laboratory tests, has demonstrated the real need for this service, and the demand on the laboratory facilities is constantly increasing. Over 5000 mineral determinations a year are now being made by the Division of Mines and Mining.



## LIBRARY

SAM P. SENIOR, JR., Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines and Mining contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

## OFFICIAL PUBLICATIONS RECEIVED

## Governmental.

U. S. Geological Survey:

Professional Papers:

- 144 The Copper Deposits of Michigan (with maps) by B. S. Butler and W. S. Burbank.

Bulletins:

- 593 The Fauna of the Batesville Sandstone of Northern Arkansas.  
 594 Some Mining Districts in Northeastern California and Northwestern Nevada.  
 595 Fauna of the So-called Boone Chert near Batesville, Arkansas.  
 596 Geology and Coal Resources of North Park, Colorado.  
 797-B The Skwentna Region, Alaska. By S. R. Capps.  
 797-C Preliminary Report on the Sheenjek River District, Alaska. By J. B. Mertie, Jr.  
 797-D Surveys in Northwestern Alaska in 1926. By P. S. Smith.  
 797-E Aerial Photographic Surveys in Southeastern Alaska. R. H. Sargent and F. H. Moffit.  
 805-B Deposits of Vermiculite and Other Minerals in the Rainy Creek District Near Libby, Montana. By J. T. Pardee and E. S. Larsen.  
 806-B The Northward Extension of the Sheridan Coal Field, Big Horn and Rosebud Counties, Montana. By A. A. Baker.  
 806-C Geology and Oil and Gas Prospects of Part of the San Raphael Swell, Utah. By J. Gilluly.  
 806-D Geology of the Rock Creek Oil Field and Adjacent Areas, Carbon and Albany Counties, Wyoming.  
 810-A Mineral Industry of Alaska in 1927, and Administrative Report. P. S. Smith.

## Water Supply Papers:

- 589 Surface Water Supply of the U. S., 1924, Part IX, Colorado River Basin.
- 593 Surface Water Supply of the U. S., 1924, Part XII, North Pacific Slope Drainage Basins. (B) Snake River Basin. (C) Lower Columbia River Basin and Pacific Slope.
- 594 Drainage Basins in Oregon.
- 597-A Geology of Reservoir and Dam Sites with a report on the Owyhee Irrigation Project, Oregon. By K. Bryan.

## U. S. Department of Agriculture:

- A Forest Fire Prevention Handbook for School Children.

## U. S. Coast and Geodetic Survey:

- Earthquake History of the U. S. (Exclusive of the Pacific Region). By N. H. Heck. (Special Publication No. 149.)
- Seismological Report No. 431, for Oct., Nov., Dec., 1926.

## U. S. Bureau of Mines:

## Technical Papers:

- 410 Falls of Roof in Bituminous Coal Mines. By J. W. Paul.
- 413 Roasting of Lead-Carbonate Ores Preliminary to Gravity Concentration. By V. Miller and R. E. Head.
- 438 Bentonite: Its Properties, Mining, Preparation, and Utilization. By C. W. Davis and H. C. Vacher.

## Bulletins:

- 295 Subsidence and Ground Movement in the Copper and Iron Mines of the Upper Peninsula of Michigan.

## Bibliography:

- Recent Articles on Petroleum and Allied Substances,

## Mineral Resources of the U. S.:

- Stone in 1927.
- Barite and Barium Products in 1927.
- Cement in 1927.
- Clay in 1927.
- Chromite in 1927.
- Mica in 1927.
- Lime in 1927.
- Sand and Gravel in 1927.
- Silver, Copper, Lead and Zinc in the Central States in 1927.
- Manganese and Manganiferous Ores in 1927.
- Gold, Silver, Copper and Lead in S. Dakota and Wyoming in 1927.
- Natural Gasoline in 1927.
- Tin in 1927.
- Talc and Soapstone in 1927.
- Gold, Silver, Copper, Lead and Zinc in California and Oregon in 1927.
- Asbestos in 1927.
- Natural Gas in 1927.
- Phosphate Rock in 1927.

## Reports of Investigations.

## Serial No.:

- 2908—Carbon Monoxide from Automobiles Using Ethyl Gasoline. By W. P. Yant and L. B. Berger.  
(Gives results of tests which show that use of Ethyl gasoline as motor fuel has no appreciable effect on carbon monoxide content of exhaust gases.)
- 2909—A Preliminary Investigation of Rubber-Sheathed Concentric-Type Trailing Cables for Mining Machines. By L. C. Hsley and A. B. Hooker.  
(Outlines results of preliminary tests of cables of type named, made to determine their characteristics as to safety and durability with a view to their use on "permissible" mining equipment.)



- 2910—Potash from New Jersey Greensand: Preliminary Report. By J. R. Thoenen.  
(Discusses feasibility of various proposed processes for recovery of potash from the extensive New Jersey greensand deposits. Contains information regarding geology; probable production and market centers; freight rates; costs; and by-products.)
- 2911—Study of Quarry Costs. By J. R. Thoenen.  
(Summarizes preliminary compilation of operation costs at a large number of limestone quarries during 1927 prepared from questionnaires filled in by operators.)
- 2912—The 1, 3 Dimethyl-2-Phenoxyacetic Acid. By Ralph L. Brown and Briant F. Branting.  
(Outlines method of preparation of a xylenol derivative used in studying mixtures of phenols present in low-temperature tars.)
- 2913—A study of Gauze Heating in Miners' Flame Safety Lamps. By E. J. Gleim, A. B. Hooker, and P. G. Guest.  
(Summarizes tests for measurement of temperature of gauzes used in flame safety lamps, in order to determine whether overheating of the gauze may cause ignition of surrounding atmosphere.)
- 2914—Control of a Small Mine Fire with Rock-Dust. By H. C. Howarth and George McCaa.  
(Gives details of method by which a small coal-mine fire was controlled by covering the hot coals with a blanket of rock-dust.)
- 2915—Official changes in the Active List of Permissible Explosives for February, 1929.  
(Supplements complete list of permissible explosives published June 30, 1928, as Serial 2879 and notices of changes in active list of permissible explosives issued as Serials 2891, 2900 and 2907.)
- 2916—Nineteenth Semiannual Motor Gasoline Survey. By E. C. Lane, D. B. Taliaferro, Jr., and S. S. Taylor.  
(Discusses characteristics of motor gasoline samples taken in 12 widely scattered cities in the United States during January, 1929.)
- 2917—The Melting Point of Potassium Chromate. By David F. Smith and F. A. Hartgen.  
(Gives results of careful redetermination of details regarding melting point of potassium chromate, used for detecting temperature to which a coal sample should be heated in standard method of analysis to determine volatile matter content.)
- 2918—The Wire Saw in Slate Quarrying. By Oliver Bowles.  
(Summarizes recent progress in utilization of wire saw in slate quarrying, which is resulting in greatly increasing rate of making cuts of slate.)
- 2919—Laboratory and Field Tests of the Martiensen Permissible-Type Methane Detector. By A. B. Hooker, W. J. Fene, and R. D. Currie.  
(Summarizes tests of new type of device for detecting presence of methane in gassy mines by noting effect of methane on color or brightness of electrically heated filament.)
- 2920—A New Permissible Blasting Device. By J. E. Tiffany  
(Describes new type of device which utilizes liquid carbon dioxide as a blasting agent.)
- 2921—Coarse Sand Flotation Classification and Table Concentration. By A. W. Fahrenwald and Clarence Thom.  
(Describes tests in development of a concentration process embodying flotation, classification, and tabling. The process is particularly applicable to simple ores containing a single mineral which is liberated wholly or to a large degree from the gangue at relatively coarse comminution.)
- 2922—Official Changes in the Active List of Permissible Explosives for March, 1929.  
(Supplements complete active list of permissible explosives issued in July, 1928, as Serial 2879 and Serials 2891, 2900, 2907 and 2915, noting official changes in this list.)

## Information Circulars.

- 6093—Factors Affecting Falls of Roof and Coal. By J. W. Paul.  
(In connection with detailed study of causes and prevention of falls of roof and coal in mines, emphasizes importance of operators reporting full details of all accidents of this nature.)
- 6094—The Classification of North American Coals. By A. C. Fieldner.  
(Summarizes work being done looking toward a systematic classification of North American coals by American Engineering Standards Association and various subcommittees.)
- 6095—Work of the Holmes Safety Association at Baton Rouge, Louisiana. By F. E. Cash.  
(Gives outline of safety activities among employees of a large oil refinery.)
- 6096—State Regulations Governing Explosion Proof Type Electric Motors in Coal Mines. By L. C. Ilsley.  
(Analyzes laws of various states regarding safeguarding of electric-motorized equipment used in gassy coal mines.)
- 6097—List of Permissible Mining Equipment.  
(Supplements complete list of permissible mining equipment, mine rescue apparatus and gas masks published in July, 1928, as Information Circular 6077 and includes equipment tested and approved by Bureau of Mines to January 1, 1929.)
- 6098—Electrical Safety Inspection: Suggestions for Mine-Safety Engineers. By L. C. Ilsley.  
(A revision of Serial 2541, published in November, 1923. Presents important mine safety points that should be watched by inspectors, and briefly reviews work of Bureau of Mines in testing of electrical mining apparatus and equipment.)
- 6100—Electrical Accident Prevention. By L. C. Ilsley.  
(Discusses methods for safeguarding electrical mining equipment and prevention of electrical accidents in mines.)
- 6105—Mining Laws of British Africa. By John W. Frey.  
(Another of the series of papers presenting digests of foreign mining legislation and court decisions relative to the right of American citizens to explore for minerals and to own and operate mines in various foreign countries.)
- 6106—Auxiliary Power Units for Fan Operation. By F. E. Cash.  
(Describes various types of auxiliary or emergency power units for operating mine fans, installed in Alabama coal mines to supplement regular ventilation system.)
- 6107—Mining Practice at Morenci Branch, Phelps Dodge Corporation, Morenci, Ariz. By Henry Mosier and Gerald Sherman.  
(The first of a series of publications dealing with the caving method of mining. Contains history of district and outlines early and modern methods and accident prevention measures, with data on wage system and operation costs.)
- 6108—State Regulations Governing Inspection and Maintenance of Electrical Equipment in Coal Mines. By L. C. Ilsley and R. A. Kearns.  
(Analyzes various State mining codes with a view to determining wherein they may be lacking in providing proper legislation governing use of electricity in mines from a safety standpoint.)

## U. S. Department of Commerce:

## Bureau of Foreign and Domestic Commerce:

- Distribution Cost Studies No. 4: The Wholesale Grocer's Problems.  
Monthly Summary of Foreign Commerce of the U. S.  
Part II, December 1928.  
Part I, January 1929.

## Alabama Geological Survey:

- Museum Paper No. 8. The Terrestrial Shell-Bearing Mollusca of Alabama.

## California Department of Public Works:

- Division of Water Rights:  
Biennial Report, Nov. 1st, 1928.

**California State Library:**

News Notes of the California Libraries. Annual Statistics Number, Vol. 23, No. 4.

**Connecticut State Geological and Natural History Survey:**

Bulletin No. 43. The Life Forms of Connecticut Plants and Their Significance in Relation to Climate.

Bulletin No. 44. Report on the Water Resources of Connecticut. By R. H. Suttie.

**Illinois State Geological Survey:**

List of Publications on the Geology of Illinois to January 1st, 1929.

The Rock River Country of Northern Illinois. By D. Rolfe.

Press Bulletin Series 17: Illinois Petroleum.

Report of Investigations 17: The Limestone Resources of the Pontiac-Fairbury Region. By J. E. Lamar.

Bulletin 32: Coal Stripping Possibilities in Saline and Gallatin Counties near Equality.

Bulletin 56: Illinois Coal. By A. Bement.

**Indiana Department of Conservation:**

Tenth Annual Report: For year ending Sept. 30th, 1928.

**Montana Bureau of Mines and Metallurgy:**

Memoir 1: The Kevin-Sunburst and Other Oil and Gas Fields of the Sweet-grass Arch.

**Nevada:**

Biennial Report of the State Inspector of Mines. 1927-1928.

**Pennsylvania Geological Survey:**

Bulletin 5: New Castle Quadrangle.

Bulletin 27: Pittsburgh Quadrangle.

**Barcelona: Real Academia de Ciencias y Artes:**

Vol. XX, No. 15. La Teoria Diferencial y Los Numeros Aproximados.

Vol. XXI, No. 1. Especia Ictiologica Notable.

2. Sesion Publica Extraordinaria. Memorias Necrologicas.

3. El Analisis Electrolitico.

5. Notas Sobre un Rasgo Genuino de la Pintura Espanola.

6. Rectificadores en Vapor de Mercurio.

7. Le Expresion de las Manos en Las Pinturas Primitivas y en el Teatro.

8. Contribucion el Estudio de Derivados Etenicos.

**British Museum of Natural History:**

Catalogue of the Rock Collections in the Mineral Department of the, Part I, Africa.

**Canada Department of Mines:**

Bulletin 50: Annual Report for 1926.

Economic Geology, Series No. 5. Oil and Gas in Western Canada.

Summary Report, 1927, Part C.

Investigations of Mineral Resources and the Mining Industry, 1927.

**Canada: Dominion Fuel Board:**

Second Progress Report—1923-1928.

**Colombia Museo Nacional:**

Los Minerales de Colombia.

**England Geological Survey Memoirs:**

Wells and Springs of Sussex.

The Geology of the Country Around Ramsgate and Dover.

**Italy: Ministero Dell' Economia Nazionale:**

Relazione sul Servizio Minerario nel 1927.



**Mexico:**

Boletin del Petroleo:

Vol. XXVI, Nos. 4, 5, and 6. Oct., Nov., and Dec., 1928.

Boletin Minero:

Tomo XXVII Nos. 1 and 2.

**Mexico: Instituto Geologico de Mexico:**

Boletin Num. 46.

**Netherlands:**

Congres pour l' Avancement des Etudes de Stratigraphie Carbonifere.

**New Zealand: Dominion Laboratory:**

61st Annual Report, 1928.

**Nova Scotia: Department of Public Works and Mines:**

Report on the Mines for 1928.

**Ontario Bureau of Mines:**

General Index to the Reports of the, Volumes I to XXV (1891-1916).

XXVI to XXXV (1917-1927).

37th Annual Report: Vol. XXXVII, Part II, 1928, on Kirkland Lake Gold Area (with maps).

Bulletin 68: Preliminary Report on the Mineral Production of Ontario for 1928.

37th Annual Report, Part III.

**The Philippine Journal of Science:**

Vol. 37, No. 4. Dec., 1928.

Vol. 38, No. 1. Jan., 1929.

**Quebec Department of Colonization, Mines and Fisheries:**

Mineral Production in Quebec in 1928, Preliminary Statement.

**South Australia: Geological Survey:**

Bulletin 13: Pigment Materials in South Australia.

**Western Australia Geological Survey:**

Annual Progress Report of the, for 1927.

**Societies and Educational Institutions.****American Institute of Mining and Metallurgical Engineering:**

Transactions: Vol. 76, 1928.

**The American Mineralogist: Journal of the Mineralogical Society of America:**

Vol. 14, Nos. 2 and 3. Feb. and March, 1929.

**Annual Report of the Director of the Association for the Study of Negro Life and History:**

July 1st, 1927, to June 30th, 1928.

**American Philosophical Society:**

Proceedings. Vol. LXVII, No. 4, 1928.

**California Fish and Game:**

Vol. 15, No. 1, January, 1929.

**California Academy of Sciences:**Vol. XVIII, No. 1. A New Species of *Corambe* from the Pacific Coast of North America.2. A New Bird Family from the Galapagos Islands (*Geospizidae*).

3. A Contribution to Our Knowledge of the Nesting Habits of the Golden Eagle.

**Canadian Mining and Metallurgical Bulletin:**

No. 202, Feb., 1929.

No. 203, March, 1929,

## Engineers Society of Western Pennsylvania:

Vol. 44, No. 9, Dec., 1928.

Vol. 44, No. 10, Jan., 1929.

## Field Museum of Natural History:

Publication 254. Vol. IV, No. 5: Contributions to Paleontology. By S. K. Roy.

Famous Diamonds (Geology Leaflet No. 10). By O. C. Farrington.

## Institute of Economic Mineralogy and Metallurgy:

Transactions: Nos. 35, 39, 40, 41.

## Institute of Mining and Metallurgy:

Bulletin of the, No. 293, Feb., 1929.

No. 294, March, 1929.

## Journal of the Western Society of Engineers:

Vol. XXXIV, Nos. 2 and 3, February and March, 1929.

## Mining and Metallurgical Society of America:

Bulletin 198, Jan., 1929, Vol. 22, No. 1.

199, Feb. 1929, Vol. 22, No. 2.

Vol. 21. 1928 Proceedings.

## National Research Council:

Reprint and Circular Series: Report of the Committee on Sedimentation--  
1927-1928.

## New York Academy of Sciences:

Vol. XXX, pp. 129-176: The Inheritance of Resistance of Oat Hybrids to  
Loose and Covered Smut. Pp. 177-261: Geological Reconnaissance of Parts  
of Grand, Jackson and Larimer Counties, Colorado. Pp. 263-296: The  
Geology and Ore Deposits of the Buffalo Hump District.

## Philadelphia Academy of Natural Science:

Proceedings: Vol. LXXX, 1928.

## San Diego Society of Natural History:

Transactions, Vol. V, No. 13, No. 14, No. 15.

## Smithsonian Institution:

Report on the International Exchange Service, 1928.

No. 2766. Miargyrite Silver Ore from the Randsburg District, California.

No. 2758. Tschermigite, Ammoniojarosite, Epsomite, Celestite, and Paligor-  
skite from Southern Utah.

No. 2768. Mineralogy and Geology of Cerro Mercado Durango, Mexico.

## U. S. Library of Congress:

Monthly Check List of State Publications: Oct., Nov., 1928, Nos. 10 and 11.

## News Notes of California Libraries:

Index, Vol. 23, Nos. 1-4, 1928.

Vol. 24, No. 1, January, 1929.

## University of California Press:

The Straitigraphy of Parson Bay, B. C.

Influence of Rudder Shapes on Steering.

A New and Remarkable Hedgehog from the Later Tertiary of Nevada.

A New Goose from the Lower Pliocene of Nevada.

The California Tapir, Santa Barbara County.

A Second New Genus of Hedgehog from the Pliocene of Nevada.

## Colorado School of Mines Magazine:

Vol. 19, Nos. 2 and 3, Feb. and March, 1929.

Publication No. 156, No. 158.

## State University of Iowa:

New Series Bulletins, No. 478, Oct., 1928.

## Minnesota Chats:

Vol. 11, No. 113, Feb., 1929.

## Minnesota University Bulletins:

240, 241, 242, 243, 244.

## New Mexico School of Mines:

Bulletin 4: Fluorspar of New Mexico.

## University of Oregon:

An Aberrant Oyster from the Oregon Eocene. By E. L. Packard.

## Tohoku Imperial University, Sendai, Japan:

Science Reports, Second Series (Geology), Vol. XII, No. 1.

## "Economic Geology":

Vol. XXIV, Nos. 1 and 2, Jan., Feb., March and April, 1929.

## "Rocks and Minerals":

Vol. 4, No. 1, March, 1929.

## Books.

"Deforested America." By Major G. P. Ahern. 70th Congress, 2d Session. Senate Document No. 216.

"Gazetteer of the Mountains of the State of California."

"American Newspaper Annual and Directory," 1929.

"Keystone Metal and Quarry Catalogue."

"Hydraulic Laboratory Practice" (American Society of Mechanical Engineers).

"The Mineralogy of the Rarer Metals." By Cahen and Wootton.

"Revenue Laws of California," 1928.

"Methods in Nonferrous Metallurgical Analysis." By Keffer.

"Ceramics—Clay Technology." By Wilson.

## Maps.

U. S. Geological Survey Topographic:

Utah: Fort Douglas Quadrangle.

Hawaii: Koolau Q.

Haleakala Q.

California: Fresno and Kings Counties: Westhaven Quadrangle.

## Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.

Architect and Engineer, San Francisco.

Arizona Mining Journal, Phoenix, Arizona.

Asbestos, Philadelphia, Pennsylvania.

Brick and Clay Record, Chicago.

Bulletin, Union Oil Co., Los Angeles.

California Journal of Development, San Francisco.

Cement, Mill and Quarry, Chicago, Illinois.

Chemical-Engineering and Mining Review, Melbourne, Australia.

Engineering and Mining Journal, New York.

Explosives Engineer, Wilmington, Del.

Financial Insurance News, Los Angeles, California.

Graphite, Jersey City.

Journal of Electricity and Western Industry, San Francisco.

Mine and Quarry, Chicago.

Mining and Engineering Record, Vancouver, B. C.

Mining and Oil Bulletin, Los Angeles.

Oil Age, Los Angeles.

Oil and Gas Journal, Tulsa, Oklahoma.

Oil and Gas News, Kansas City.

Oil News, Galesburg, Illinois.

Oildom, New York.

Oil, Paint and Drug Reporter, New York.



Oil Trade Journal, New York.  
 Oil Weekly, Houston, Texas.  
 Petroleum Age, New York.  
 Petroleum Record, Los Angeles.  
 Petroleum World, Los Angeles.  
 Queensland Government Mining Journal, Brisbane, Australia.  
 Rock Products, Chicago, Illinois.  
 Safety News, Industrial Accident Commission, San Francisco.  
 Salt Lake Mining Review, Salt Lake City, Utah.  
 Southwest Builder and Contractor, Los Angeles.  
 Standard Oil Bulletin, San Francisco.  
 Stone, New York.  
 The Record, Associated Oil Company, San Francisco.  
 Through the Ages, Baltimore.

#### Newspapers.

Amador Dispatch, Jackson, California.  
 Barstow Printer, Barstow, California.  
 Beaumont Gazette, Beaumont, California.  
 Calaveras Prospect, San Andreas, California.  
 California Miner, San Francisco, California.  
 California Oil World, Los Angeles, California.  
 Colusa Daily Sun, Colusa, California.  
 Daily Commercial News, San Francisco, California.  
 Daily Midway Driller, Taft, California.  
 Del Norte Triplicate, Crescent City, California.  
 Denver Mining Record, Denver, Colorado.  
 Exeter Sun, Exeter, California.  
 Goldfield News, Goldfield, Nevada.  
 Inyo Independent, Independence, California.  
 Inyo Register, Bishop, California.  
 Ione Valley Echo, Ione, California.  
 Mojave Miner, Kingman, Arizona.  
 Mountain Messenger, Downieville, California.  
 Nevada City Nugget, Nevada City, California.  
 Nevada Mining Press, Reno, Nevada.  
 Oil Refinery News, Bayonne, New Jersey.  
 Palo Verde Valley Times, Blythe, California.  
 Placer Herald, Auburn, California.  
 Plumas Independent, Quincy, California.  
 San Diego News, San Diego, California.  
 Shasta Courier, Redding, California.  
 Siskiyou News, Yreka, California.  
 Sotoyome Scimitar, Healdsburg, California.  
 Stockton Record, Stockton, California.  
 Tuolumne Prospector, Tuolumne, California.  
 Waterford News, Waterford, California.  
 Weekly Trinity Journal, Weaverville, California.  
 Western Sentinel, Etna Mills, California.

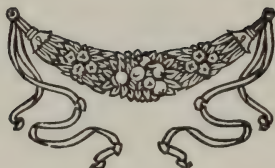
## PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *MINING IN CALIFORNIA* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of *MINING IN CALIFORNIA*, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for *MINING IN CALIFORNIA*.



## EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.







## PUBLICATIONS OF THE DIVISION OF MINES AND MINING

During the past forty-eight years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines and Mining, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines and Mining.

NOTE.—The Division of Mines and Mining frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

### REPORTS

Asterisks (\*\*) indicate the publication is out of print.

	Price
<b>**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks</b> -----	-----
<b>**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks</b> -----	-----
<b>**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks</b> -----	-----
<b>**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks</b> -----	-----
<b>**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks</b> -----	-----
<b>**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks</b> -----	-----
<b>**Part II, 1887, 222 pp., 36 illustrations. William Ireland, Jr.</b> -----	-----
<b>**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Ireland, Jr.</b> -----	-----

## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.-----	-----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.-----	-----
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.-----	-----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.-----	\$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford-----	-----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper-----	-----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper-----	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper-----	-----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper-----	-----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper-----	-----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper-----	-----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper-----	.65
**Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper-----	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper-----	-----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50



## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920. Fletcher Hamilton: 562 pp., 71 illustrations, cloth-----	1.75
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy-----	\$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties-----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties-----	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties-----	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties-----	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo counties, also report on Minaret District, Madera County-----	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island-----	.25
April, 1927, Mines and Mineral Resources of Amador and Solano counties-----	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles counties-----	.25
October, 1927, Mines and Mineral Resources of Mono County-----	.25
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1928, Mines and Mineral Resources of Tuolumne County-----	.25
April, 1928, Mines and Mineral Resources of Mariposa County-----	.25
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties-----	.25
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties-----	.25
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly.	
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines-----	.25
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties-----	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)-----	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919-----	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920-----	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921-----	Free

## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
January, February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1926-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1927-----	Free
January, February, March, April, May, June, July, 1928-----	Free

## BULLETINS

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations-----	-----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations-----	-----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps-----	-----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)-----	-----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations-----	-----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston. 85 pp., 46 illustrations-----	\$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations-----	-----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.-----	-----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations-----	-----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale-----	-----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899-----	-----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations-----	-----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations-----	-----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps-----	-----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899-----	-----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet-----	-----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet-----	-----

## BULLETINS—Continued

Asterisks (\*\*) indicate the publication is out of print.

Price

Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps.	\$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps.	
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet.	
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps.	
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet.	
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet.	
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps.	
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet.	
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California.	
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps.	
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations.	
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map.	
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet.	
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps.	
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps.	
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	
**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet.	
**Bulletin No. 48. Mineral Production of California for Twenty Years, 1906, by Charles G. Yale.	
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet.	
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet.	



## BULLETINS—Continued

Asterisks (\*\*) indicate the publication is out of print.

Price

**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.	-----	
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet.	-----	
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet.	-----	
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.	-----	
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps.	-----	
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet.	-----	
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet.	-----	
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	-----	
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet.	-----	
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet.	-----	
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps.	-----	
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†Bulletin No. 81. Foothill Copper Belt of California. (In preparation)	-----	

† Not yet published.

## BULLETINS—Continued

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**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello. 1920. 124 pp., paper-----	-----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper-----	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leek, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth-----	-----
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Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth-----	\$1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley. 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth-----	1.50
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Bulletin No. 101. California Mineral Production for 1927, by Henry H. Symons, 1928. 311 pp., paper-----	Free

## PRELIMINARY REPORTS

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.-----	-----
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**Preliminary Report No. 6. A Review of Mining in California During 1913. Fletcher Hamilton, 1920. 43 pp. Paper-----	-----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper-----	-----

## PRELIMINARY REPORTS—Continued

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- \*\*Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper-----

## MISCELLANEOUS PUBLICATIONS

- \*\*First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.-----
- \*\*Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.-----
- \*\*Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.-----
- \*\*Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.-----
- \*\*Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.-----
- \*\*Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.-----
- \*\*Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894-----
- \*\*Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper-----
- Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper-----
- Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923-----

Free

Free

## MAPS

## Register of Mines With Maps.

- \*\*Register of Mines, with Map, Amador County-----
- \*\*Register of Mines, with Map, Butte County-----
- \*\*Register of Mines, with Map, Calaveras County-----
- \*\*Register of Mines, with Map, El Dorado County-----
- \*\*Register of Mines, with Map, Inyo County-----
- \*\*Register of Mines, with Map, Kern County-----
- \*\*Register of Mines, with Map, Lake County-----
- \*\*Register of Mines, with Map, Mariposa County-----
- \*\*Register of Mines, with Map, Nevada County-----
- \*\*Register of Mines, with Map, Placer County-----
- \*\*Register of Mines, with Map, Plumas County-----
- \*\*Register of Mines, with Map, San Bernardino County-----
- \*\*Register of Mines, with Map, San Diego County-----
- Register of Mines, with Map, Santa Barbara County (1906)-----
- \*\*Register of Mines, with Map, Shasta County-----
- \*\*Register of Mines, with Map, Sierra County-----
- \*\*Register of Mines, with Map, Siskiyou County-----
- \*\*Register of Mines, with Map, Trinity County-----
- \*\*Register of Mines, with Map, Tuolumne County-----
- Register of Mines, with Map, Yuba County (1905)-----
- Register of Oil Wells, with Map, Los Angeles City (1906)-----

\$0.25

.25

.35

## OTHER MAPS

- \*\*Map of California, Showing Mineral Deposits (50 x 60 in.)-----
- \*\*Map of Forest Reserves in California-----
- \*\*Mineral and Relief Map of California-----
- \*\*Map of El Dorado County, Showing Boundaries, National Forests-----
- \*\*Map of Madera County, Showing Boundaries, National Forests-----
- \*\*Map of Placer County, Showing Boundaries, National Forests-----
- \*\*Map of Shasta County, Showing Boundaries, National Forests-----



## OTHER MAPS—Continued

Asterisks (\*\*) indicate the publication is out of print.

Price

**Map of Sierra County, Showing Boundaries, National Forests	----	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----	----
**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
Map of Minaret District, Madera County	----	\$0.20
Map of Copper Deposits in California	----	.05
**Map of Calaveras County	----	----
**Map of Plumas County	----	----
**Map of Trinity County	----	----
**Map of Tuolumne County	----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	----	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	----	.75
Mounted	----	2.00
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92 (also sold singly) In 4 colors	----	.50

## OIL FIELD MAPS

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County	----	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	----	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc	----	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	----	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	----	.75
Map No. 6—Salt Lake, Los Angeles County	----	.75
Map No. 7—Sunset and San Emido and Kern County	----	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County	----	.75
Map No. 9—North Midway and McKittrick, Kern County	----	.75
Map No. 10—Belridge and McKittrick, Kern County	----	.75
Map No. 11—Lost Hills and North Belridge, Kern County	----	.75
Map No. 12—Devils Den, Kern County	----	.75
Map No. 13—Kern River, Kern County	----	.75
Map No. 14—Coalinga, Fresno County	----	1.00
Map No. 15—Elk Hills, Kern County	----	.75
Map No. 16—Ventura-Ojai, Ventura County	----	.75
Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County	----	.75
Map No. 18—Piru-Simi-Newhall Oil Fields	----	.75
Map No. 19—Arroyo Grande, San Luis Obispo County	----	.75
Map No. 20—Long Beach Oil Field	----	1.25
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties	----	.75
Map No. 21A—Portion Kern and Kings Counties	----	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County	----	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County	----	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties	----	.75
Map No. 26—Huntington Beach Oil Field	----	.75
Map No. 27—Santa Fe Springs Oil Field	----	.75
Map No. 28—Torrance, Los Angeles County	----	.75
Map No. 29—Dominguez, Los Angeles County	----	.75

## OIL FIELD MAPS—Continued

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Map No. 30—Rosecrans, Los Angeles County-----	\$0.75
Map No. 31—Inglewood, Los Angeles County-----	.75
Map No. 32—Seal Beach, Los Angeles and Orange Counties-----	.75
Map No. 33—Rincon, Ventura County-----	.75
Map No. 34—Mt. Poso, Kern County-----	.75
Map No. 35—Round Mountain, Kern County-----	.75
Map No. 36—Kettleman Hills, Kings County-----	1.25

## DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines and Mining for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.





STATE OF CALIFORNIA  
DIVISION OF MINES AND MINING  
CORDIALLY INVITES YOU TO VISIT  
ITS VARIOUS DEPARTMENTS MAINTAINED  
FOR THE PURPOSE OF FURTHERING  
THE DEVELOPMENT OF THE  
MINERAL RESOURCES OF CALI-  
FORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily  
Saturday, 9 a.m. to 12 m.

Walter W. Bradley,  
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.

Branch Offices: New Orpheum Building, Los Angeles; State Office Building, Sacramento; Chamber of Commerce, Redding; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria and Santa Paula.

# Mining in California



PUBLISHED QUARTERLY

STATE OF CALIFORNIA  
DIVISION OF MINES AND MINING

FERRY BUILDING  
SAN FRANCISCO

## DIVISION OF MINES AND MINING

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### EXECUTIVE AND TECHNICAL STAFF

---

WALTER W. BRADLEY

*State Mineralogist*

#### MINING DIVISION

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C. A. LOGAN, District Mining Engineer	-	-	-	-	-	Sacramento
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REID J. SAMPSON, Assistant District Engineer	-	-	-	-	-	Los Angeles
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FRANK SANBORN, Mineral Technologist	-	-	-	-	-	San Francisco
HERBERT A. FRANKE, Junior Mining Engineer (Librarian)	-	-	-	-	-	San Francisco

#### DEPARTMENT OF PETROLEUM AND GAS

R. D. BUSH, State Oil and Gas Supervisor	-	-	-	-	-	San Francisco
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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the Division of Mines and Mining, entitled 'Summary of Operations, California Oil Fields.'



STATE OF CALIFORNIA  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF MINES AND MINING  
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY

State Mineralogist

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Vol. 25

JULY, 1929

No. 3

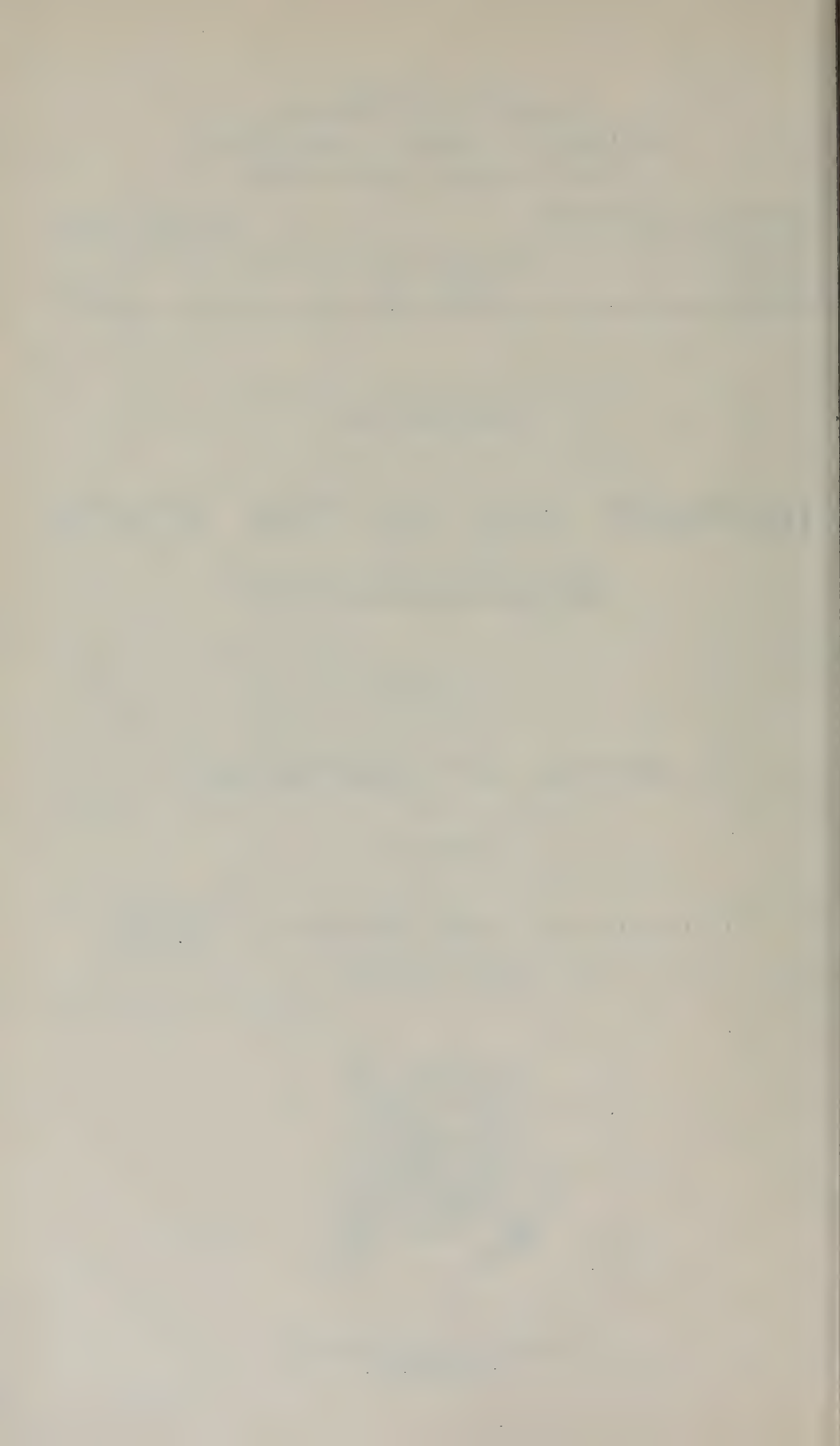
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CHAPTER OF  
  
REPORT XXV OF THE STATE  
MINERALOGIST

COVERING  
  
MINING IN CALIFORNIA

AND THE  
  
ACTIVITIES OF THE DIVISION OF MINES  
AND MINING

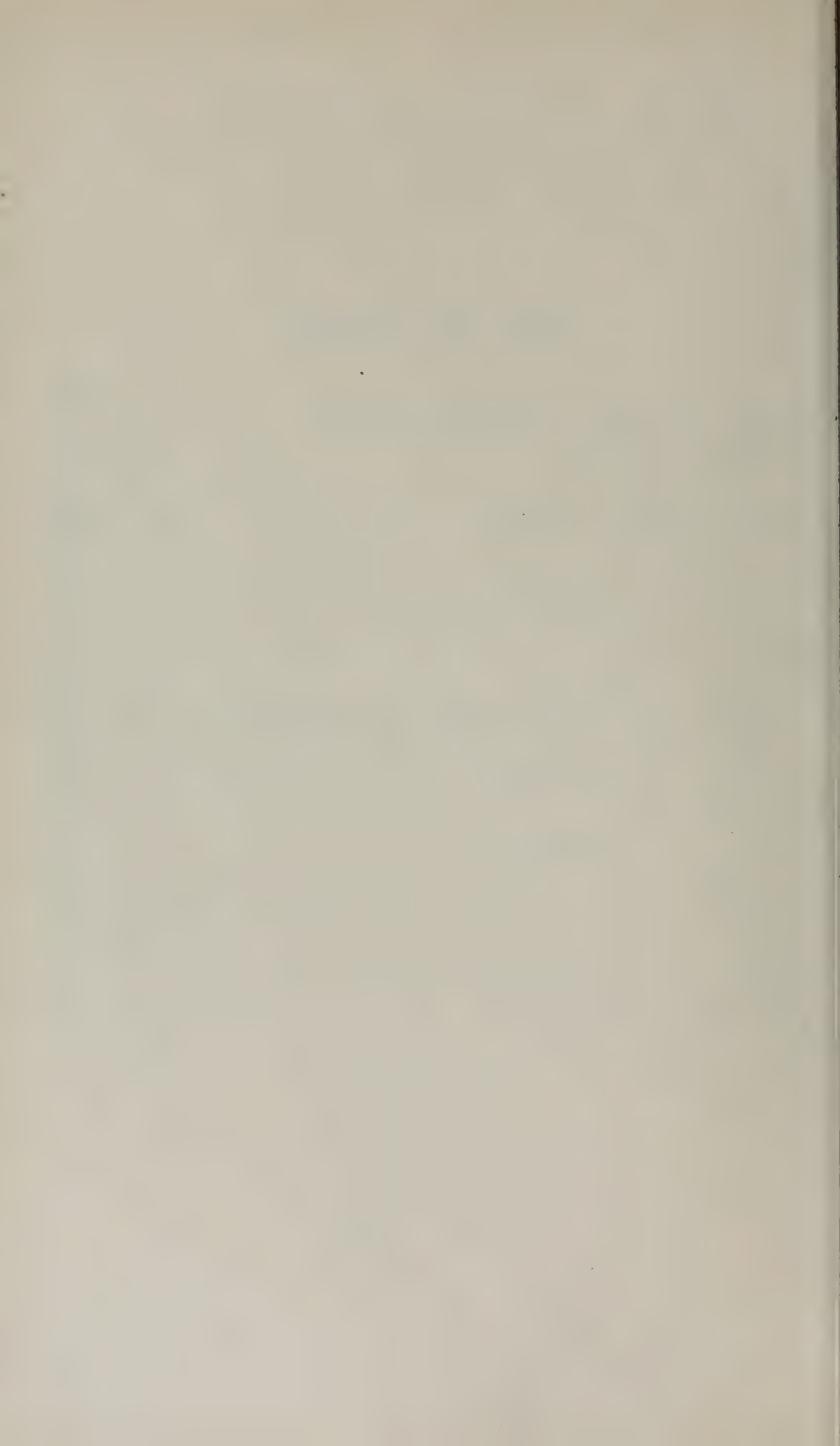




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## PREFACE

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The Division of Mines and Mining (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines and Mining.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

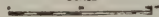
The one aim of the Division of Mines and Mining is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

State of California  
DIVISION OF MINES AND MINING  
WALTER W. BRADLEY

STATE MINERALOGIST

OUTLINE MAP  
OF  
CALIFORNIA

SCALE



•LEGEND•

- Mining Division Boundaries.
- Mining Division Offices.



## DISTRICT REPORTS OF MINING ENGINEERS

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In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

### New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It was deemed advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

### REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field Division, as Mr. Chas. V. Averill, District Mining Engineer in charge, has been temporarily assigned to field work in the San Francisco Division.

**SACRAMENTO FIELD DIVISION**

C. A. LOGAN, Mining Engineer

**COLUSA COUNTY****Geography.**

Colusa, the second county north of Sacramento on the west side of Sacramento Valley, has good railroad service and highways in the valley section, while the western part is connected by good dirt and gravel roads with Lake County on the west. The eastern half of the county lies in the Sacramento Valley adjacent to Sacramento River and is entirely devoted to agriculture. The western half, a part of the east slope of the Coast Ranges, is adapted chiefly for raising cattle and sheep, but has some mines and many mineral springs.

**Geology.**

From three to six miles west of the railroad (which traverses the valley section in a northwesterly direction) the contact of Cretaceous beds of sandstone, shale and conglomerate extends the entire length of the county. These beds, which here have not been definitely classified as either Upper or Lower Cretaceous because of a lack of distinctive fossils, have a width of from seven to fifteen miles and cover most of the western, hilly half of the county. A narrow wedge of Tertiary sediments extends northward from Sites to the northerly county line, being a mile wide at the most here, where it separates the valley sediments from the older rocks. On the west, the Cretaceous beds are in contact with the Franciscan formation, composed of altered sandstone, slate, chert and glaucophane schists, intruded by serpentine and to a lesser extent by other igneous rocks.

**Mineral Resources.**

The principal minerals produced in the county, in the order of total values, have been sandstone, produced from massive beds in the Cretaceous formations, near Sites; mineral water from the springs in the western area; miscellaneous stone, from sandstone quarries and from gravel pits in the valley section; quicksilver from mines near Wilbur Springs and west of there in the Franciscan rocks and at their eastern contact with the Cretaceous beds, and gold from several small deposits of unusual character in the same contact area. Salt, mineral paint, brick, chromite, copper, limestone, sulphur, natural gas and petroleum have all been produced in small quantity and prospects of gypsum, pyrite and manganese have been noted.

The last complete report on the mineral resources of the county was published by the California State Mining Bureau (now the State Division of Mines) in 1915. Since then there has been a pronounced falling off in mining activity until the past two years. The recent work has been confined to reopening of some of the old quicksilver mines and the drilling of numerous 'wildcat' wells in search of petroleum. The 1915 report is still available. The present notes are intended to bring to date the record of operations and ownerships of the more

important properties. There has been no new development to report since 1915 so far as the following minerals are concerned. For mention of these, reference should be made to the publications cited:

Borax—State Mineralogist's Report III, p. 16; Bull. 24, pp. 69, 70.

Brick Clay—State Mineralogist's Report VIII, p. 159; Bull. 38, p. 242.

Coal—State Mineralogist's Report VIII, p. 158; X, p. 158; XI, p. 188.

Copper—State Mineralogist's Report VIII, p. 159; X, p. 158, 261; Bull. 50, pp. 159, 160.

Gypsum—Bull. 38, p. 283.

Iodine—State Mineralogist's Report X, p. 164; XI, pp. 180, 181; Bull. 24, pp. 107, 114.

Limestone—State Mineralogist's Report X, p. 158; Bull. 27, p. 45; Bull. 38, p. 66.

Manganese—U. S. Geol. Survey, Bull. 427, p. 164.

Salt—State Mineralogist's Report X, p. 164; R. XI, p. 180; Bull. 24, pp. 107, 114; U. S. Geol. Survey, W. S. P. 338, p. 298.



## MINERAL PRODUCTION OF CALIFORNIA

Year	Gold and silver, value	Quicksilver		Sandstone	
		Flasks	Value	Cubic feet	Value
1875		700	\$58,905		
1876		407	17,908		
1877		466	17,382		
1878					
1879					
1880	\$4,908				
1881	3,500				
1882	2,575				
1883	1,000				
1884	1,530				
1885	45,000				
1886	11,617				
1887	7,461				
1888	6,000				
1889	13,626				
1890	2,810				
1891					
1892					
1893	300				
1894				20,000	\$7,500
1895		1	40		
1896		58	2,054		
1897		43	1,510		
1898					
1899					
1900		275	12,359		
1901	1,800	235	10,575	88,981	80,000
1902	850	605	26,500	99,395	87,450
1903		510	21,708	146,828	312,500
1904		400	16,526	100,000	290,000
1905		326	12,321	118,954	276,900
1906				88,821	101,800
1907	742	17	648	86,954	78,250
1908	584	21	900	73,284	43,970
1909	4	11	545	47,070	24,630
1910	4			112,947	56,500
1911	3,118	5	230	101,029	50,020
1912				51,137	15,800
1913				34,927	15,550
1914				16,000	7,300
1915					
1916		285	26,648		
1917					
1918					
1919					
1920					
1921					
1922	4				
1923					
1924					
1925					
1926					
1927					
Totals	\$107,421	4,365	\$226,359	\$1,186,327	\$1,448,298

<sup>1</sup>Includes crushed rock, rubble, rip-rap, sand, gravel.

<sup>2</sup>1880 to 1890, U. S. Mint reports.

<sup>3</sup>Flasks of 75 pounds since 1904; previously 76½ pounds.

<sup>4</sup>Included with Lassen County production.

<sup>5</sup>Includes Lassen County production.

<sup>6</sup>See under 'Unapportioned.'

COUNTY, 1875-1927.

[illegible]

## ARAGONITE (See ONYX MARBLE)

## CHROMITE

During the World War, a few small chromite prospects were opened in the serpentine areas in the western part of the county near Wilbur Springs and Stonyford. These prospects were from 25 to 33 miles west of the railroad. A small production was made in 1918, but nothing has been done recently with the claims. The various prospects are mentioned in Bulletin 76, pages 123, 124 and 216.

## GOLD (and SILVER)

Gold occurs in the Sulphur Creek district at several properties under unusual conditions. The Manzanita and Cherry Hill (later called the Cerise) mines on opposite sides of Sulphur Creek were small producers of gold over quite a long period. The Clyde Mine, three miles northwest, was also a producer.

*Cherry Hill Mine* (*Cerise, Gold Mountain* or *Montezuma* and other claims of *Manzanita Group*) is in NE $\frac{1}{4}$  Sec. 29, T. 14 N., R. 5 W., on the south side of Sulphur Creek at the old village of Sulphur Creek, a mile west of the present Wilbur Springs. The Cherry Hill, and the Manzanita on the north side of the creek are similar except that on the south side the rock is generally somewhat coarser grained, being sandstone, while shale predominates on the north side.

The beds of mineralized sandstone and shale are from 100 to 120 feet wide and about 300 feet long, so far as the gold prospects are concerned, although cinnabar occurs farther north in the Manzanita. The best ore is in narrow seams filled with siliceous sinter, carrying incrustations of free gold in the shallow oxidized zone, which in depth gives way to sulphides. The whole mass, outside the seams, is so low in gold content that attempts to work it on a large scale have failed. The sandstone contains some cinnabar (less on the south than on the north side) mineral salts and at times bituminous matter. There is a serpentine dike nearby.

Cherry worked the property successfully in a small way for many years, as he mined and milled only the best ore from the seams and crushed it in arrastres. His production is said to have been from \$1,800 to \$5,000 annually. Both properties have been sampled several times. In 1920, Ellis, Turman and Austin formed a company and installed considerable machinery, with a pipe line 8000 feet long to obtain fresh water from Bear Creek. (See Report XVII, of State Mineralogist, 1917, p. 46.) This venture failed. In 1928 Hosea B. Turman, Willows, and associates gave a deed to parts of the Manzanita, North Star and Monticella to Gold Mountain Mines, Incorporated. This company evidently did little on the property and at present a suit is pending, brought by *Colusa Gold Mines Company* versus *Gold Mountain Mines, Inc.*, and *Fremont Grant, Inc.*, to quiet title to the holdings.



The workings consist of a number of shallow open cuts, adits and drifts. Sulphides are said to appear at a depth of about 20 feet. About 1000 feet of workings have been run.

Bibl: State Mineralogist's Report VIII, pp. 157, 158; XI, pp. 184, 185; XVII, p. 46; Bull. 27, pp. 44, 45; Bull. 78, pp. 38, 39.

*Clyde Mine* is in the SE $\frac{1}{4}$  Sec. 12, T. 14 N., R. 6 W., about five miles northwest of Wilbur Springs. It was described in detail in the Eleventh Report of the State Mineralogist where it is stated: "This mine seems to be at the contact of serpentine and a soft slate, or shale, traversed by numerous veinlets of quartz. \* \* \* About 1886-87 Mr. Haskin relocated the claim, and sank a shaft to a depth of about 146 feet in the slate; he struck rich gold-bearing ore, which is said to have consisted of decomposed slate \* \* \* at a depth of 90 feet, a large quantity of pyrites was encountered, but the ore is said to have deteriorated."

One or more Huntington mills were used on the property, which has been idle for many years. The last known owners were S. H. Smith, Leesville, and J. O. Briant, Abbott Mine via Wilbur Springs.\*

Bibl: State Mineralogist's Report XI, p. 183; XIII, p. 126; XIV, p. 179.

*Manzanita Mine* is in NW $\frac{1}{4}$  Sec. 29, T. 14 N., R. 5 W., just north of Sulphur Creek and a mile west of Wilbur Springs. The property as described in past reports included the Manzanita and Cherry Hill gold mines as well as the part worked for quicksilver (which see, *post*).

The property has been the principal gold producer of the county. Considerable work has been done on the hillside just north of Sulphur Creek, where the gold ore was mined by open cuts, shallow adits and drifts. The geology of the deposit is similar to that of the Cherry Hill Mine except for the presence of more cinnabar and the fact that the rock is a sandy shale and has been more actively leached than at the Cherry Hill. Several geologists who have written reports on the mine have mentioned interesting phenomena connected with the action of the mineralized water of the hot salino-sulphur springs so common in the district. This ascending solfataric water has invaded the sandstone and shale, leaching out the more easily soluble minerals in narrow sections along the walls of numerous cracks and bedding planes, and has deposited gold, cinnabar, sulphur compounds and siliceous sinter or opaline silica. According to Forstner<sup>1</sup> this action is still going on. Some of the narrow seams of ore have been quite rich but as a whole the ore was low grade, running from \$1 to \$2 a ton, and usually extending no more than 75 feet below the surface. Selected ore is reported to have averaged \$32 a ton.

Several mills, including one of ten stamps and later three Huntington mills with concentrators and amalgamating pans, have been used. The soft shale was cheaply mined and milled, but the gold was so fine

<sup>1</sup> Forstner, Wm., Cal. State Min. Bur. Bull. 27, p. 45.

that the ore had to be ground to pass an 80-mesh screen. In spite of the statement frequently made that the gold was difficult to recover because of the presence of bitumen and sulpho-salts, it was stated in Report XI of the State Mineralogist that the tailings seldom exceeded 25 cents a ton. The concentrate was reported to carry from \$100 to \$200 a ton in gold. None of the gold mining and milling equipment is left in working order, and this part of the mine has been idle many years. The title is at present involved in litigation.

Bibl: State Mineralogist's Report VIII, pp. 157, 158; R. X. p. 160; R. XI, pp. 184, 185; R. XII, p. 359; R. XIII, p. 126; Bull. 27, pp. 44, 45; Bull. 78, pp. 38, 39.

#### MINERAL PAINT

*Ruby King Mineral Paint Mine* is in Secs. 29 and 31, T. 17 N., R. 6 W., four miles south of west of Lodoga and 27 miles by road from Arbuckle, the nearest railroad point. The 40 acres of patented ground on which the mill and principal workings were, have been sold to the state for unpaid taxes and nearly all movable equipment has been removed. The unpatented mining claims have reverted to the public domain. No work has been done for several years. What little paint mineral there is left in sight appears quite siliceous. It occurs irregularly in lumps and small masses.

Bibl: State Mineralogist's Report XIV, p. 180; Bull. 50, p. 160; U. S. G. S. Mineral Resources 1910, Pt. 1, p. 697; 1911, Pt. 1, p. 901; 1912, Pt. 1, p. 939.

#### MINERAL WATER

The mineral springs of the county have been described in detail by G. A. Waring<sup>1</sup> and Bradley.<sup>2</sup> To these reports, which are both still available, it is only necessary to add details of present condition and ownerships of the properties, and brief mention of the recent trend in the summer resort and vacation business, to which most of these springs looked for business in the past.

The widespread use of the automobile and the building of good highways have changed the vacation habits of thousands in the state, who make long tours rather than spend the time at one resort, however attractive. This has resulted in a diversion of business from many of the mineral springs, especially from those which are any distance from heavily traveled roads. Only those springs whose waters have a reputation for marked medicinal properties have escaped this. In this latter class are the hot salino-sulphur springs of Colusa County. The possibilities of the county along this line are only partly exploited, as numerous hot springs are not utilized at present.

The mineral springs of the county are of two general types—first, the hot salino-sulphur springs feeding Sulphur Creek, and second, scattered groups of cool carbonated springs. All the springs are in the western, hilly section at or near the contact of the Cretaceous sedimen-

<sup>1</sup> Waring, G. A., Springs of California; U. S. Geol. Survey, Water Sup. Pap. 338, 1915.

<sup>2</sup> Bradley, Walter W., Cal. State Min. Bur. Mines & Mineral Resources of Colusa et al. counties, 1915.

taries and the Franciscan metamorphic rocks and their accompanying intrusives.

*Blanch's Hot Sulphur Springs* is on the Wide Awake Mine and about one-fourth mile west of Sulphur Creek school. Ruth E. and Ella G. Gibson, owners, 1317 Linden Street, Oakland. Formerly a small resort was maintained here. The sinking of the Wide Awake shaft diverted the flow of hot water from the spring, and the resort was closed. After the work at the mine stopped in 1900, the shaft filled nearly full and one of the springs resumed its flow, about three miners inches when visited. The resort buildings burned years ago and the water is not utilized. It is salino-sulphur water, temperature 104° F.

*Cook's Mineral Springs*. Assessed to E. L. Bosquit, 914 Seventh Street, Sacramento. These cool carbonated springs are 32 miles by road west of Williams, at elevations of 1550 to 1870 feet. For many years this was a popular resort and a large quantity of the water was bottled annually for general sale. The hotel and 35 cottages had accommodations for 325 people. In 1928 a forest fire destroyed the entire establishment except six small cabins. When visited in June, 1929, the place was deserted. None of the water has been bottled for several years.

*Elgin Mine Hot Springs* (original Wilbur Springs) at the Elgin Quicksilver Mine, four miles west of Wilbur Springs P. O., are part of the mine property and are owned by W. S. Norman, Spokane, Washington. They are of great interest geologically and because of the mineral content and high temperature of the water. These springs and the minerals they deposit are described herein under Elgin Mine in the section on quicksilver, as well as in the references previously cited. The water is of salino-sulphur type with silica, iron, aluminum and hydrogen sulphide prominent.

Water from one of the groups of springs here was formerly used at the original Wilbur Springs resort, and in common with similar nearby springs, very interesting cases of marked alleviation of rheumatism and other diseases have been claimed for it when used for bathing and taken internally. This water is now running unused into Sulphur Creek.

*Fouts Springs* are in the northwest corner of the county at the eastern side of Snow Mountain, about 35 miles from Willows or 50 miles from Williams. The property, comprising 1350 acres, patented, is held in trust by the Bondholders' Committee of *L. J. Lowrey Properties, Incorporated*. Warren Davis, local representative, Stony Ford.

The four principal springs are of cool, carbonated water, with some salt, iron, calcium and magnesium. Iodine has also been reported in small amount from the New Life and Red Eye Springs.

The property is pleasantly located and has a hotel, cottages and bottling works. For many years it was a popular resort, and water was bottled for sale, but when visited in June, 1929, the place was closed to the public and no water has been bottled for three years or more.

*Jones Hot Sulphur Springs* are on Sulphur Creek between the present Wilbur Springs and the old site of Sulphur Creek village. These



springs have passed into the possession of *Wilbur Springs Company*, J. W. Cuthbert, manager, Wilbur Springs P. O. The several springs and two drilled wells discharge hot salino-sulphur water of the same general character as found at Wilbur, Blanck and other nearby springs. The 'Geyser' or 'Fountain of Life,' is a well furnishing most of the water. This was cased and a concrete tower 12 feet high surrounds it. Artesian pressure and the periodic accumulation of small quantities of gas cause the water here to spurt at regular intervals of about 45 minutes a little above the casing. The intervals are longer and energy of discharge less than formerly.

*Wilbur Hot Sulphur Springs* are 26 miles by good road west of Williams. J. W. Cuthbert, Wilbur Springs P. O., is principal owner of Wilbur Springs Company. The property comprises nearly 2000 acres, but the springs forming the nucleus of the enterprise are along Sulphur Creek for about one-half mile. The springs have been frequently described. There are claimed to be about 30 springs in all (not including those on the Jones Hot Springs property, adjoining on the west and now under the same ownership). Of these, 12 are the most important, and most of these are of hot salino-sulphur water, utilized principally for water and mud baths. Three small cold springs, two called magnesia and the other a sulphur spring are used for drinking. The property has a small concrete hotel building, two rooming houses and several cottages, giving accommodations for 175 people, and there is also a group of bathhouses where the water is used by many patrons who claim to obtain relief for rheumatism and other diseases. This is the only mineral spring resort now operating in the county.

#### ONYX MARBLE

*Warwick Group* of claims, comprising Cleopatra, Good Luck No. 1 and No. 2 and Argonite claims have been located one mile north of the north end of the Elgin Mine, covering a deposit of onyx marble. Harry C. Warwick, 3769 Jackson Street, San Francisco, owner.

No work has been done by the present owner on the deposit, which has been known for years. It was not visited by the writer, but is said to show as a capping about one foot thick, 20 feet wide and 150 feet long. Polished specimens are of a beautiful brown banded stone. It is probably a hot spring deposit. Gerald A. Waring<sup>1</sup> mentions such a ledge of onyx marble as crossing Sulphur Creek about one-half mile upstream from the Elgin Mine.

In Report VIII of the State Mineralogist, page 159, it is stated that a quantity of 'aragonite' was marketed in England years ago from this locality.

#### PETROLEUM

Numerous seepages of oil have been noted in the vicinity of Wilbur Springs along Bear Creek, and a little oil has also been found in wells drilled near Mountain House (Venado P. O.) and about one mile southwest of there on Salt Creek. The most interesting of these is the 'Gibson Gusher,' about one-half mile above the first bridge northeast of Wilbur Springs on the road to Williams and on the hillside west of

<sup>1</sup> U. S. G. S., Water Sup. Pap. 338, p. 106.

Bear Creek. Oil had been observed issuing in small quantity with the water from a spring, for many years before any attempt was made to exploit it. In 1899 the spring was cleaned out and a little digging released enough oil to result in the loss of several hundred gallons. Nothing was done to utilize it and soon after the spring was filled up to prevent further loss.

On the 290-foot level of the Wide Awake quicksilver mine, a mile west of Wilbur Springs, a seepage of heavy oil of paraffin base ( $15^{\circ}$  Baumé) was opened in 1900. It was found on the contact of the serpentine orebody with the Cretaceous shale of the hanging wall. According to A. A. Gibson, then owner, it yielded one-half barrel a day while the mine was open (until July 1, 1900). It was used at the mine for lubricating the steam engines, and 800 gallons was shipped. Samples said to be of this oil, are nearly black. Tests of it yielded 20 different grades of products, several of which are classed as good cylinder oils. It contained no gasoline nor other light fractions and the residue was coke. The light amber-colored oil found near Salt Creek southeast of Venado was also reported devoid of gasoline and kerosene. The occurrence of the oil in crevices in the serpentine, or at the serpentine-shale contact, indicates it is migratory, having come from the shale. The character of the oil shows that the lighter fractions have evaporated or have been driven off by heat. The high temperatures underground at the shallow depths reached, the numerous hot springs and evidences of solfataric action give credence to the idea of heat acting on the oil.

Vander Leek,<sup>1</sup> after weighing the factors favorable and unfavorable to the accumulation of oil in this region, concluded that "it would appear that wells drilled along the axes of the anticlines and faults should obtain showing of oil and, possibly, under the most favorable conditions, obtain small quantities of oil."

The following wells were drilled in Colusa County previous to 1921, with results as indicated by Vander Leek:

"(1) Unnamed well drilled in the NW $\frac{1}{4}$  of Sec. 23, T. 20 N., R. 5 W., about the year 1902; depth 2900 feet; located in a syncline in the Chico; show of gas and oil reported. (2) Williams Oil Company 'Brim Well,' located in the SE $\frac{1}{4}$  of Sec. 15, T. 15 N., R. 4 W.; drilled to a depth of 2540 in the Chico; considerable gas reported. (3) Williams Oil Company 'Granger Well,' located in the NE $\frac{1}{4}$  of Sec. 18, T. 15 N., R. 4 W., on the axis of a faulted anticline; drilled to a depth of 600 feet in the Knoxville shales; good showing of oil reported from 75 to 600 feet. (4) Williams Oil Company well, located in the NE $\frac{1}{4}$  of Sec. 17, T. 15 N., R. 4 W.; drilled to a depth of 1400 feet in the Chico; showing of oil and gas reported. (5) Williams Oil Company 'Mountain House Well,' located in the SE $\frac{1}{4}$  of Sec. 18, T. 5 N., R. 4 W., on the axis of a faulted anticline; drilled to a depth of 1300 feet in the Knoxville; good showing of gas reported at 1042 feet; well still shows a small flow of gas. These wells of the Williams Oil Company were drilled between 1901-1909. (6) At the present time (April, 1921) the Mountain House Standard Oil Company is drilling a well in the NE $\frac{1}{4}$  of Sec. 18, T. 15 N., R. 4 W. A depth of 715 feet has been reached and a good showing of light oil is reported. (7) Unnamed well in NW $\frac{1}{4}$  of Sec. 32, T. 15 N., R. 4 W.; shallow; still shows small amount of gas. (8) Three wells are reported as having been drilled on Sand Creek, in Secs. 7 and 8, T. 13 N., R. 3 W.; reported depths were from 1000 to 1500 feet and showings of gas and oil were said to have been encountered, one well still showing a small amount of gas. These wells are located approximately on the axis of an anticline in the uppermost Chico. (9) On the west side of Bear Creek, about one mile north of Wilbur Springs, several shallow wells were drilled near the contact of the Knoxville and Franciscan and close to the seeps that occur there. Showings of oil and gas were reported from these wells. (10) In the SW $\frac{1}{4}$  of Sec. 35, T. 15 N., R. 5 W., the Herron Oil Company sank a well to a depth of 1000 feet in the serpentine. At the present time (April, 1921) a tunnel is being driven into the serpentine, just south of the Herron well, by the Blue Ridge Petroleum Company. Crevices in the serpentine have yielded as much as a barrel of light amber oil. As stated above this can be regarded only as a freak occurrence of petroleum. The oil undoubtedly

<sup>1</sup> Cal. State Min. Bur. Bull. 89, Chap. VI, July, 1921.



migrated from the shales which are found outcropping about 500 yards east of the tunnel. (11) At the present time the Blue Ridge Petroleum Company is drilling a well in the SW $\frac{1}{4}$  of Sec. 34, T. 13 N., R. 3 W. The well is located approximately on the axis of a sharply folded anticline."

Since 1921, the following companies are or have recently been active in drilling wildcat wells:

*Amalgamated Oil Company* of Nevada. G. A. Taber, Oroville, California, secretary. Leased 220 acres from Golden State Oil Company in W $\frac{1}{2}$  of Sec. 27, T. 14 N., R. 5 W. Between 1921 and 1927 a well was drilled beside Bear Creek, 0.6 miles southwest of the highway. Early in 1927, when a depth of 2845 feet had been reached, the pump and about 2500 feet of pipe were lost in the well and efforts to clear it have failed. Indications of oil were reported at 900, 1500, 2000 and 2825 feet in depth. This well is in the Cretaceous sandstone near the contact of a dike of serpentine cutting across the strike of the sandstone.

*Calavada Superior Oil Company*, Clay Peters Building, Reno, Nevada. Calavada No. 1 well, drilled by Williams Oil Company is just west of Salt Creek in the SE $\frac{1}{4}$  of NE $\frac{1}{4}$  of SE $\frac{1}{4}$  of Sec. 31, T. 15 N., R. 4 W., three miles southeast of Venado. This well, 721 feet deep, produced for a few weeks at the rate of one-half to one barrel daily of clear, light amber-colored oil, and still produces a small amount by pumping. This oil is being sold for medicinal uses. It is claimed to contain a small amount of ichthyol. Calavada No. 2 well, 316 feet deep, close to their No. 1 well, was not a producer.

*Colus Oil Company*, William B. Brown, president and manager, P. O. Box 415, Williams is drilling Colus No. 1 well in NE $\frac{1}{4}$  of SE $\frac{1}{4}$  of Sec. 31, T. 15 N., R. 4 W., adjacent to Calavada No. 1 and No. 2. They have 200 acres under lease. The well was 870 feet deep when visited May 23 and was being deepened a few feet daily. It is equipped with a steel derrick 114 feet high and a good rig capable of reaching greater depth than heretofore drilled in the county. Showings of oil were reported at 380, 810, 848 and 868 feet but drilling was continued past these in search of deeper sands. A water shut-off was made at 812 feet.

*E. & G. Products Company* is drilling a well on land sub-leased from Calavada Superior Oil Company near Venado. This well was about 800 feet deep May 20.

*Golden State Oil Company* of Nevada, Reno, has held leases on oil rights on 1125 acres of land along Bear Creek and nearby, just east of Wilbur Springs and belonging to J. W. Cuthbert et al., Wilbur Springs. This company has done no drilling, but sub-let 220 acres to Amalgamated Oil Company (see, *ante*).

*Mountain House Standard* well near Venado was drilled to a depth of 1390 feet. It produced a small flow of gas, but no oil.

*Prize Oil & Gas Company* put down a well near College City in which they claimed to have struck indications of oil at 535 feet and gas at 800 feet, neither evidently in much quantity. This well was 900 feet deep at last report, but the total depth is not known.

*Smith & Vickers* have recently started a well about three-fourths mile west of Mountain House.



## QUICKSILVER

The geology and past operations of the quicksilver mines and prospects of Colusa County have been described by Forstner<sup>1</sup> and Bradley<sup>2</sup> and in various state and U. S. government reports of earlier date, particularly by G. F. Becker in U. S. Geological Survey, Monograph 13, 1888. There had been very little work done on these mines from 1918, when Bradley's bulletin was issued, until the past year, when the increased price of mercury led to a renewal of interest and work started at several old mines in this state. The following notes give the present status of those mines in Colusa County where activity has been resumed, as seen during field trips in May.

The Sulphur Creek district includes about eight square miles in western Colusa County and the small adjacent area in Lake County, all west and northwest of Wilbur Springs, a mineral spring resort 26 miles by good road west of Williams on the Southern Pacific railroad. This is the only mining district in the county and has produced all of the gold and quicksilver credited to the county.

The country rock is Cretaceous sandstone and shale, near the contact of Franciscan rocks on the west. The sedimentary rock has been invaded by a series of dikes of serpentine, trending northwest. One of these runs along the ridge forming the county line and here the Abbott Mine was found. Another crosses Sulphur Creek just west of Wilbur Springs. On and near the contact of this serpentine and the Cretaceous rocks are the Manzanita, Central and Empire workings. Midway between the two serpentine belts, which here are a mile apart, the Wide Awake and old Buckeye mines lie along the contact of a small serpentine dike.

The basin of Sulphur Creek is noted for its numerous hot springs of salino-sulphur water. These are no doubt the last stages of the solfataric action which has deposited sulphur and metallic sulphides and has altered the serpentine, changing it in places to an opaline rock. The sandstone and shale have also been leached by such water and the seams and cracks have been filled with opaline layers. Cinnabar and gold, the latter free in the surface zone of oxidation but at greater depth with pyrite, occur in the seams with and without the siliceous sinter, and much more sparingly, or not at all, in the leached and altered rock as a whole. The alteration and leaching have been especially marked at the Manzanita and Elgin mines. At the latter, action has been so intense that the rock has been thoroughly altered and contains as much as 50% sulphur.

The hot water and high underground temperature have hampered the working of several of the mines in this district, particularly the Elgin, Empire and Wide Awake. The water destroys clothing and corrodes tools and pipe.

*Central and Empire Group* includes Central, Little Giant and Dewey Claims (Central) on the north side of Sulphur Creek in Secs. 28, 29, T. 14 N., R. 5 W., and the Hidden Treasure, Mercury Queen and Mercury King claims (Empire) on the south side of the creek in section

<sup>1</sup> Forstner, Wm., Cal. State Min. Bur. Bull. 27, 1908.

<sup>2</sup> Bradley, Walter W., Cal. State Min. Bur. Bull. 78, 1918.

29, in all 70 acres. The property adjoins Wilbur Springs resort on the west and is 26 miles by road west of Williams on the railroad.

The production has been from the Central ground. In 1926 lessees mined and treated sufficient ore to produce several thousand dollars worth of mercury, but the exact amount is uncertain, being estimated at \$10,000 or more. The mine was idle and deserted when visited in May, 1927, and one of the owners stated the exact output was not known to him. A small rotary furnace was installed, but was not successfully operated and the production was made from six retorts.

The deposit on the Central is in serpentine near the contact with shale on the east. Cinnabar occurs in the upper workings as seams in a blanket deposit 25 to 30 feet wide. The rich seams of cinnabar cut in all directions through the serpentine which had been altered and mineralized by hot water probably of the same general character as that issuing in such quantity from the hot springs along Sulphur Creek immediately adjoining this property. In some of the seams opaline silica forms the gangue, though most of them contain soft cinnabar. Several hundred feet of irregular workings, similar to the usual 'gophering' practice followed in many small Californian mercury mines, were run on the upper level, which is scarcely 50 feet below the top of the ridge. In the lower level a crosscut was run north about 100 feet and from it drifts were run about 160 feet northwest and 50 feet southeast. The only visible showing of ore observed in this level was a seam of cinnabar about one-half inch wide, in a gouge striking N. 65° W. which had been followed in the drifts. The rest is probably low in mercury content.

Ore was lowered to the creek, about 200 feet below the workings, by tramway. The retorts are on land belonging to J. W. Cuthbert.

No work has been done recently on the Empire portion of the holdings. There is an old shaft 110 feet deep which is said to show a good prospect in the bottom, where a flow of hot water was encountered. There are some short adits on these claims.

The portion of this property north of Sulphur Creek was reported under lease and option to H. M. Newhall & Co. in May, 1929, but no work was being done.

*Elgin Mine* and millsite are Lots 38a and 28b in SE $\frac{1}{4}$  Sec. 13, T. 14 N., R. 6 W., with 160 acres of patented land adjoining in Sec. 18, T. 14 N., R. 5 W. W. S. Norman, Spokane, Washington, owner. *Pacific Sulphur and Industrial Minerals Company*, Financial Center Building, San Francisco, lessee with option. This is a Nevada company of 2,000,000 shares capitalization. The property is near the head of Sulphur Creek, four miles northwest of Wilbur Springs P. O. by road. The name Wilbur Springs was first applied to the hot springs on this mine. Williams, the nearest railroad point, is 30 miles east.

Watts described the geology of the deposit in Report XI of the State Mineralogist and Forstner and Bradley have added later data in their bulletins on the quicksilver industry (see Bibliography).

The hot springs of salino-sulphur water issuing on the Elgin are of great interest. The shale and serpentine country rock has been altered by the hot water and gases. Large quantities of crystalline sulphur, calcium and magnesium carbonates and opaline silica have been



deposited. The temperature of water issuing from the 'Hot Tunnel' is variously reported to be from 138° F. to 152° F. This adit is said to have been run about 180 feet into the hill, with a drift 60 feet northwest, crosscuts of 60 and 80 feet, and a raise of 60 feet to the surface. Judging by the present high temperature within this adit at a distance of scarcely 20 feet from the portal, this must have been difficult work; the choking sulphurous and ammoniacal vapors affect the eyes and lungs and the minerals in the water destroy clothes and shoes. The 'Burned Tunnel' where the sulphur content of the rock is especially high, has a length of 97 feet including 22 feet of open cut, crosscutting the sulphur-bearing rocks. Harry C. Warwick, superintendent, stated that samples he took over a width of 22 feet here contained 52.6% sulphur. The sulphur has been burned from the rock at least near the surface for the balance of this adit.

About one-fourth mile north of the above workings which are on Big Sulphur Hill, lies Little Sulphur Hill, believed to be an extinct fumarole. For a diameter of about 150 feet here, the shale and serpentine have been altered intensely with the deposition of much crystalline sulphur, white carbonates and silica and some cinnabar. In the little draw between the two hills a spring of salino-sulphur water with a temperature of 153° F. flows at the rate of nearly two miners inches and deposits flour sulphur. Considerable open cut work has been done in the past at Little Sulphur Hill.

The past production of the property is unknown, but has been small and irregular. The last work previous to that of the present company was in 1918, when Harry C. Warwick put up a small plant for producing sulphur. The close of the war terminated this work after some experimental production, but before any commercial output was made. Previous attempts to produce and ship sulphur had failed, the last previous work along this line having been done in 1891, when some black sulphur was produced. Quicksilver has been produced from the workings described above, and some gold was also recovered.

The mine workings described are on a steep hill 400 to 500 feet above Sulphur Creek. The area between the Hot Tunnel to and including Little Sulphur Hill is said to pan well in cinnabar and the slope toward Sulphur Creek is covered by loose rock of the same kind, being the material dumped from the workings. When visited in May, about ten men were employed. Three miles of road had been built, a camp had been established and work had just been started on the slope directly below the 'Hot Tunnel,' excavating for ore bin foundations. Below the coarse ore bin it was proposed to build sulphur tanks each with a capacity of 4500 pounds and in these the sulphur would be melted from the coarse ore by the use of steam. After this, the plans contemplate crushing the ore, milling it and concentrating the cinnabar in sluice boxes fitted with riffles. The long slope offers ample space for placing the equipment so that gravity can be utilized for the entire cycle of operations. A Fitzgerald continuous retort stands near the creek. Success in concentrating a mercury ore depends on such factors as character of gangue, condition of cinnabar and fineness of grinding. With a soft gangue and relatively large crystals of cinnabar, concentration may be a success with coarse grinding. But with a



hard gangue, fine-grained cinnabar or fine grinding, losses may be excessive.

Bibl: State Mineralogist's Reports VI, Pt. 1, p. 136; XI, p. 182; XII, p. 359; XIII, p. 594; XIV, pp. 182-184, 188, 189, 196; Bull. 27, p. 43; Bull. 78, pp. 36-38. U. S. G. S., Min. Res. 1907, Pt. 1, p. 679; 1908, Pt. 1, p. 685; 1909, Pt. 1, p. 552. Min. Res. W. of Rocky Mts., 1875, p. 14; 1876, p. 20.

*Empire* (see Central & Empire Group, *ante*).

*Grover H. Herring*, 310 Henshaw Building, Oakland, owns 80 acres in W $\frac{1}{2}$  of SE $\frac{1}{4}$  Sec. 6, T. 14 N., R. 5 W., 2 $\frac{1}{4}$  miles a little east of north of the Elgin Mine. He reports quicksilver prospects in old workings which he has recently been reopening, consisting of an adit 300 feet long and a shaft 65 feet deep. The property is for sale or lease.

*Manzanita Quicksilver Mine* is one mile west of Wilbur Springs and the present workings are over one-fourth mile north of the highway. W. W. Gibson, Wilbur Springs, is owner of this part of the property, 54 acres. H. M. Newhall & Co., Newhall Building, San Francisco, lessee with option to purchase. John Andrews, superintendent.

The property has been frequently described and notes appear herein on the former gold mining operations. For data on the geology and past work, the reader should refer to the reports cited below.

In the spring of 1929 the lessee began work by the glory hole method at the old mine on the north of property. The open pit had been connected with the old workings by a large pipe, through which the ore fell into chutes and was drawn off at the face of the adit from which it was trammed by hand to the adit portal and thence by a horse to the mill bin, several hundred feet away. The soft, shaly ore is easy to mine. When visited in May, three men were working in the pit, sorting out and sacking high grade ore from the narrow streaks and dropping the balance into the chute. From 65 to 80 carloads of 1200 lb. each were being sent to the mill daily.

In the mill, a 7 $\frac{1}{2}$ -h.p. gasoline engine furnished power for a 6-ft. double conical screen (outside mesh  $\frac{3}{8}$ -inch) with a belt conveyor feeder, and two Deister Overstrom tables. No ore was crushed but the coarse reject from the screen was dumped on the hillside and the fines concentrated on the tables, one of which handled part of the tailing from the other.

Concentrate, carrying pyrite and a good percentage of cinnabar, and sorted ore was being hauled on a sled to the retorting plant one-fourth mile away near Sulphur Creek. Water for milling was being pumped from the creek, a vertical lift of perhaps 200 feet.

There were seven retorts in use, capable of handling about 250 pounds each and a charge was retorted from 16 to 24 hours, some lime being added. About one-half cord of white oak wood, costing \$8 a cord delivered, is used in 24 hours. Nine or ten men were employed. Evidently the work being done was in the nature of prospecting. The ore being milled probably averaged a very few pounds of mercury per ton, and the sorted ore over 1% mercury.

Bibl: State Mineralogist's Reports V, p. 96; VI, Pt. 1, p. 33; VIII, pp. 157, 159; X, pp. 159, 161; XI, p. 184; XII, pp. 100,

359; XIII, pp. 126, 594; XIV, pp. 189-191; Bull. 27, pp. 44, 198, 202; Bull. 78, pp. 38, 39, 330, 331. U. S. G. S., Mon. XIII, p. 367; Min. Res. 1892, p. 147; 1902, p. 252; 1907, Pt. 1, p. 679; 1908, Pt. 1, p. 685; 1909, Pt. 1, p. 552; 1911, Pt. 1, p. 901. Eng. & Mining Jour., Vol. 96, p. 783. Min. & Sci. Press, Vol. 115, Oct. 13, 1917, p. 24 adv.

*Wide Awake Mine* (formerly Buckeye). Contains 2000 acres on the south side of Sulphur Creek adjoining on the west the Wilbur Springs resort property. The mine and furnace are about one mile from Wilbur Springs hotel, near the highway. Ruth E. and Ella G. Gibson, 1317 Linden Street, Oakland, owners.

The Buckeye workings are 600 feet northwest of the present shaft on a deposit in serpentine adjoining the shale contact. These workings, largely superficial, produced a reported total of 6000 flasks of mercury, to a depth of only 80 feet, many years ago, beginning in 1875. The Wide Awake shaft was started in 1896 and worked until July, 1900, since which date it has remained closed. During that period a Scott furnace of 24 tons capacity was built and a small production made, evidently only a few flasks. Most of the work was prospecting and developing, only a little stoping being reported.

The course of the vein is indicated by a prominent outcrop of serpentine striking northwest, and the ore dips southwest, being in the serpentine at and near the shale contact. It occurs partly in a gangue of opaline silica. The vertical shaft is 470 feet deep, timbered with 10" by 10" timbers and 3-inch lagging, and was sunk in the shale on the hanging wall side of the vein. Levels were turned at 190, 290 and 390 feet in depth. The longest stope started was 390 feet long on the 190-ft. level, but little ore was stoped, and less was treated. A. A. Gibson, the former owner, states that an average width of five feet carried a rather high-grade mercury ore and thinks a width of 16 feet will make good furnace ore. There are other unexplored veins which show possibilities on the property.

On the 290-ft. level, a seepage of heavy paraffin-base oil was cut in 1900. This yielded at the rate of one-half barrel in 24 hours. (See under Petroleum.) Other places on the extensive acreage have also been regarded as having oil possibilities, and there is a deposit of fossiliferous limestone which has been used for burning lime.

The Scott fine-ore furnace, originally designed for a capacity of 24 tons a day, is claimed by Gibson to have a much greater capacity on account of changes made by him. It is outwardly in good condition, with only a few cracks, although it has been standing 27 years. The iron braces of the condenser system were broken by the force of the earthquake of 1906, but the arched pipes themselves evidently did not suffer.

#### SANDSTONE

The Colusa Sandstone, formerly used extensively for building purposes, occurs in massive beds lying just east of Sites and extending north and south for eight miles. Two quarries were operated here before 1915. Since that time, little or no stone has been quarried, although occasional sales have been made of stone previously broken.

These quarries were formerly connected by a narrow-gauge railroad with the broad-gauge line at Colusa Junction, but this narrow-gauge road has been removed. Maxwell, nine miles east, is the nearest rail-shipping point, over a good highway.

The Colusa sandstone is of even grain and blue-gray color, and of very good quality. The beds dip east about  $45^{\circ}$  and the massive character of some of the strata permits quarrying very large blocks.

*Colusa Sandstone Company's Quarry* is in  $S\frac{1}{2}$  of  $SE\frac{1}{4}$  Sec. 20 and  $SW\frac{1}{4}$  of  $SW\frac{1}{4}$  Sec. 21, T. 17 N., R. 4 W., three-fourths mile east of Sites. It is assessed to H. L. & E. L. Knowles. Several large buildings in San Francisco were built from this stone prior to 1915, including the Ferry Building and the Monadnock Building. The quarry is idle and most of the equipment has been removed.

*McGilvray Quarry* is a short distance south of the Colusa Quarry on the same series of beds of sandstone, in Secs. 28, 29, T. 17 N., R. 4 W., nine miles from Maxwell. Assessed to McGilvray Stone Company, San Francisco. Stone from this quarry also was used in a number of well-known buildings in San Francisco, including the Flood and Kohl Buildings, Humboldt Savings Bank Building, the Palace Hotel and others. This quarry is idle and all equipment except derricks and hoists has been removed.

#### STONE INDUSTRY

When the sandstone quarries were in operation, they supplied some waste rock for use in road construction and repair. At present, a little gravel and sand is taken from stream beds in the outlying sections for road use, and also from Sacramento River. Only a nominal amount is paid for this by the county.

*Vernon R. Dennis Construction Company*, Bryte Building, Sacramento, has been operating a sand and gravel plant on Sacramento River just outside the city of Colusa.

#### SULPHUR

Sulphur is deposited by the salino-sulphur springs along Sulphur Creek, and on a larger scale is found at the Elgin Mine where attempts have been made in the past to work it commercially. Plans have been made recently to produce sulphur again at this property. See Elgin Mine, in section herein on Quicksilver.



## SAN FRANCISCO FIELD DIVISION

C. MCK. LAIZURE, Mining Engineer

## FRESNO COUNTY

## Introduction.

Fresno is one of the largest in area, as well as in population and wealth, of the interior counties of the state. When organized in 1856 it included all of what is now Madera County and a large portion of Mono and Inyo counties, as its eastern boundary extended to the Nevada state line. The creation of several counties east of the summit of the Sierras during the mining excitement of the sixties and the organization of Madera County in 1893, reduced its area practically to its present size. As now delineated it contains 5940 square miles and has a population of 128,779 (1920 census), but estimated at close to 200,000 at present.

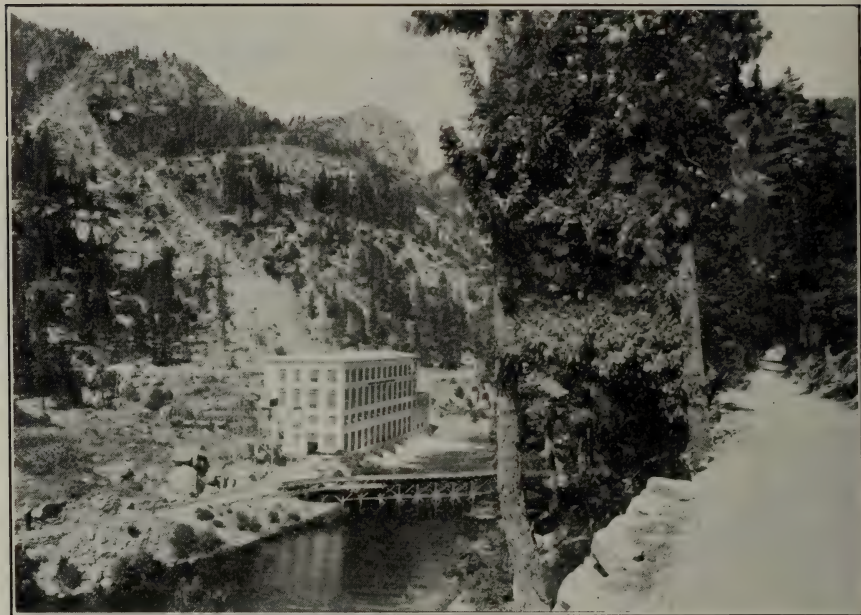
## Geography and Topography.

The central portion of the county, lying in the heart of San Joaquin Valley, is only a few hundred feet above sea level, but its eastern boundary follows the summit of the Sierras and contains numerous peaks exceeding 13,000 feet and several over 14,000 feet in elevation. The western boundary follows the crest of the first line of ridges of the Diablo Range. The county thus presents the extremes of topography, climate and industry. It is bounded on the north by Merced and Madera, on the east by Mono and Inyo, on the south by Tulare and Kings and on the west by San Benito and Monterey counties.

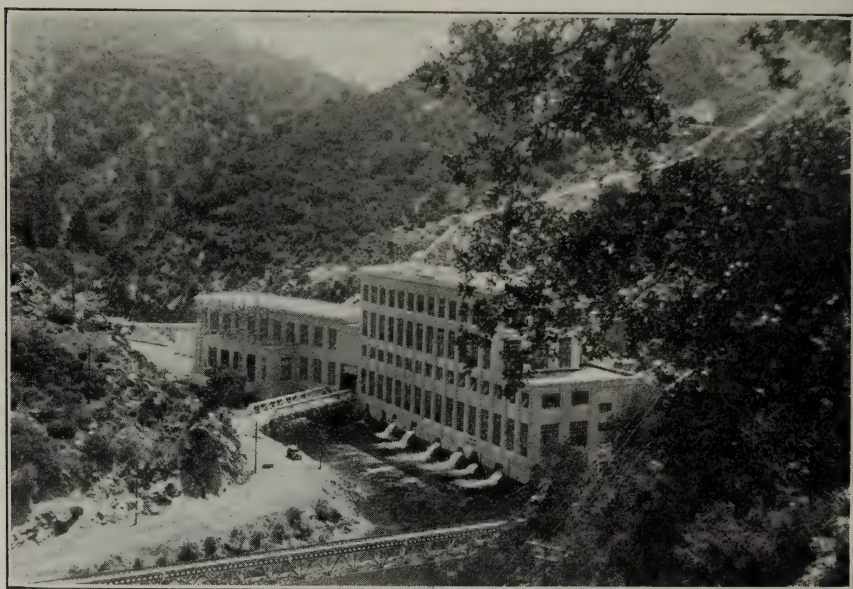
Of Fresno County's 3,808,000 acres, more than 1,500,000 are in farms and 600,400 acres are irrigated. Timber land amounts to 573,500 acres, the annual cut being about 125,000 M b.m. Nearly 1,000,000 acres are classified as pasture land. Fruits of all kinds, with grapes predominating, cotton, grain and hay, dairy products, live stock, timber, and mineral products, mainly petroleum, all contribute to the county's wealth, and its scenic and recreational features are an asset of great value.

San Joaquin and Kings rivers, and their branches, form the main drainage systems, streams on the western side being generally dry in summer.

Hydraulic power development has reached a high stage in this county, but there is still room for future additions to existing systems. San Joaquin Light & Power Company has two plants, Balch Power House on the North Fork of Kings River with 31,500 kw. output and the Kerckhoff Power House on San Joaquin River with 38,500 kw. capacity. Southern California Edison Company has five power plants in operation with a 150,000-volt transmission line to Los Angeles. These are Big Creek No. 1, 82,000 kw. capacity; Big Creek No. 2, 66,000 kw.; Big Creek No. 2A, 80,000 kw.; Big Creek No. 3, 88,000 and Big Creek No. 8, 24,000 kw. Huntington Lake, Shaver Lake and Florence Lake are artificial reservoirs supplying water to the Southern California Edison system. Power House 2A operates under a static head of 2419 feet, the water coming from Shaver Lake Reservoir, which



Southern California Edison Company's Power House No. 1, Fresno County.  
Photo by courtesy of Murphy's Art Shop, Big Creek, Cal.

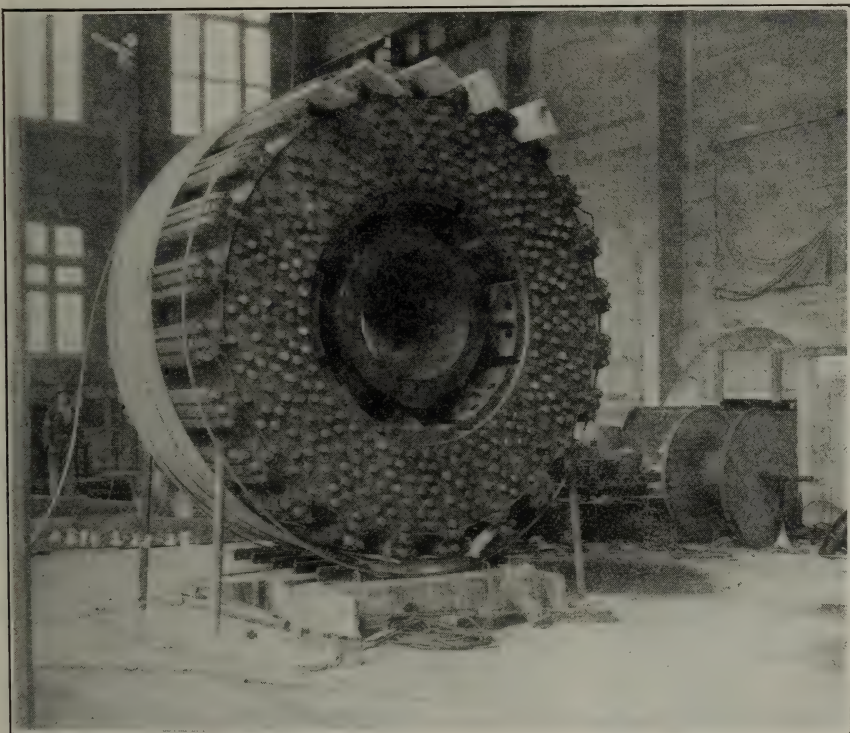


Southern California Edison Company's Power Houses Nos. 2 and 2A, Fresno County. Photo by courtesy of Murphy's Art Shop, Big Creek, Cal.



has a capacity of 135,283 acre-feet. The dam is 2169 feet long, 183 feet high and has a maximum thickness at the base of 120 feet. Florence Lake Dam is said to be the longest multiple arch dam in the world.

Two main transcontinental railway systems, the Southern Pacific and Santa Fe, transverse the county from north to south with numerous branches forming a network throughout the valley section. San Joaquin and Eastern railroad penetrates the mountainous area on the east as far as Big Creek (Cascada). Hundreds of miles of concrete and oil macadam highways give excellent transportation facilities.



Armature under construction at Power House No. 2, Southern California Edison Co. Photo by courtesy of Murphy's Art Shop, Big Creek, Cal.

#### Geology.

As indicated on the geologic map of the state, from the eastern boundary of the county southwestward for a distance of 60 miles the western slope of the Sierra Nevada is composed of deep-seated granitic rocks. Near their contact on the west with the alluvial sands, gravels and clays of the great valley there are some intrusive dikes of related igneous rocks and small areas of metamorphic limestone, schist and serpentine. The foothills and mountains of the Diablo Range on the west are composed of Tertiary and Cretaceous marine sandstones and diatomaceous shales and a small area of Franciscan sandstone, limestone, chert, jasper and serpentine.



Year	Gold, value	Silver, value	Copper		Petroleum		Brick		Miscellaneous value
			Pounds	Value	Barrels	Value	M	Value	
1880.....	\$143,433								
1881.....	90,000								
1882.....	80,000								
1883.....	100,000								
1884.....	80,000								
1885.....	74,500	\$2,456							
1886.....	151,186	2,701							
1887.....	205,242	274							
1888.....	200,000	2,800							
1889.....	185,988	4,629							
1890.....	49,951	1,816							
1891.....	82,607	10,396							
1892.....	\$112,981	26							
1893.....	7,118								
1894.....	8,202								
1895.....	47,249								
1896.....	28,235	100			14,119	\$56,750			
1897.....	43,144				70,140	70,840			
1898.....	27,557				154,000	154,000	2,500	\$18,000	
1899.....	18,142				439,372	439,372	5,500	38,500	
1900.....	22,346	479			547,960	547,960	4,250	35,062	
1901.....	21,462		1 159,672	\$182,648	525,433	236,444	5,000	35,000	
1902.....	54,427		3,000,000	345,000	571,233	199,931	6,000	45,000	
1903.....	21,538	111			2,214,160	730,673	8,000	68,000	\$18,000
1904.....	7,809	4	2,500	319	5,114,958	1,520,847	4,800	32,400	
1905.....	40,037	9,187	1,440,000	224,640	8,890,000	2,400,300	9,000	60,000	
1906.....	8,493	83	440,000	88,000	8,402,000	1,974,470	8,000	64,000	
1907.....	2,401	26	250,000	50,000	9,050,300	3,620,120	9,230	57,350	1 000
1908.....	1,054	11			10,725,389	5,898,964	13,220	106,960	1 000
1909.....	17,539	8,503	876,837	111,341	15,406,619	9,243,971	7,950	49,375	2 000
1910.....	3,373	2,980	486,725	61,999	18,651,470	9,277,241	9,533	76,267	5 000
1911.....	17,441	81			19,499,611	9,344,085	4,500	28,500	31 000
1912.....	6,094	23			19,510,932	8,487,255	5,000	40,000	30 000
1913.....	2,846	15			18,956,965	7,927,736	5,500	44,000	41 000
1914.....	10,231	31			15,952,190	7,210,389	4,500	36,000	23 000
1915.....	4,151	246	65,903	11,533	14,021,025	7,641,459	4,750	33,250	19 000
1916.....	693	69	29,173	7,177	14,594,246	7,530,631	"		9 000
1917.....	5,745	289	40,662	11,101	16,259,797	13,414,333	"		13 000
1918.....	4,795	37			16,068,919	19,138,083	and tile	89,156	24 000
1919.....	5,540	67			16,091,037	20,805,711	"		24 000
1920.....	7,793	227			15,375,454	22,801,798	12,517	196,756	53 000
1921.....	13,085	75			12,161,565	18,643,679	"		48 000
1922.....	10,442	87			9,265,529	9,895,582		220,737	600
1923.....	18,519	128			5,061,542	3,593,695	"		863
1924.....	32,978	190			10,156,405	11,801,743		95,104	451
1925.....	25,056	151			7,773,665	8,503,390	"		457
1926.....	8,595	52			7,340,102	5,982,183		87,493	388
1927.....	17,406	77			7,202,284	5,977,176		89,145	1,118
Totals.....	\$2,127,424	\$48,470	7,791,472	\$1,093,758	306,068,421	\$225,070,811		\$1,645,965	\$7,218

<sup>1</sup> Includes crushed rock, rubble, rip-rap, sand, gravel.

<sup>2</sup> To end of 1892, includes Madera County, which was created March 11, 1893.

<sup>3</sup> See under 'Unapportioned.'

[illegible]

### Mineral Resources.

Fresno County, with an annual mineral output valued at \$7,547,216 in 1927, the last year for which complete figures are available, and a total recorded output from 1880 to 1927, inclusive, of \$242,071,804, ranks sixth among the 58 counties of the state as a mineral producer. However, as petroleum is by far its most important mineral product, and oil is usually thought of in connection with an 'oil field' rather than by county lines, Fresno will probably always be best known to the general public as an agricultural county.

The commercial products in the order of their value to date are: Petroleum, stone industry, natural gas, gold, brick and tile, copper, magnesite, silver and mineral waters; with coal, gypsum, asphalt, clay, gems, chromite, quicksilver, lead, fuller's earth, diatomite, pumicite and other minerals grouped under miscellaneous and unapportioned making up the list. It will be seen that the commercial list is diversified. In addition, occurrences of asbestos, feldspar, marble, limestone, graphite, tungsten and talc, that have not been developed to date and a score of other minerals mainly of mineralogical interest are known.

The last general report upon the mineral industry in this county was published in State Mineralogist's Report XIV, 1913-14. The notes herewith, the result of two weeks field work in the county, are intended to supplement the above and bring it up to date in conformity with the new series of county reports begun in 1925.

### ASBESTOS

Asbestos has not been commercially produced in Fresno County to date, but a number of deposits have been noted.

*H. H. Miner*, Sanger, has two claims on a large deposit of amphibole asbestos situated near Minkler and within three miles of the Santa Fe Railroad.

Also reported to occur 30 miles east of Sanger:

*Webb and Mingus*, Coalinga, have a deposit of chrysotile asbestos in T. 18 and 19 W., Rs. 11 and 12 E. in the Coast Range.

Bibl: State Mineralogist's Report XIV, p. 432. State Mining Bureau Bull. 38, p. 262; Bull. 91, p. 165.

### BRICK AND CLAY

The clay resources and ceramic industry of the county are described by Dietrich,<sup>1</sup> and details will be omitted here.

No deposits of high-grade clays are known, but the alluvial silts of San Joaquin Valley have been utilized for many years in the manufacture of common brick and hollow tile. Common clay of suitable plasticity for this purpose is scarce, however, and it has often been necessary to ship in small quantities of plastic clay from outside points.

Two brick plants were in operation in 1927, but since then there has been only one producer.

<sup>1</sup> Dietrich, W. F., Clay Resources and Ceramic Industry of California, State Mining Bureau Bull. 99, 1928, pp. 77-78.



*Craycroft-Herold Brick Company.* J. F. Craycroft, president; Wm. Turner, vice president and superintendent. Office: 407 Griffith-McKenzie Building, Fresno. Plant: Crayold Siding, three miles west of Fresno. Products: Common brick, ruffled and plain face brick and hollow tile. Active.

*Pioneer Brick and Tile Company.* T. W. Hasty, president and manager. Address: P. O. Box 614, Fresno. Plant: California and Perch Avenues, south of Fresno. Common red brick is the only product. This plant was shut down in 1928.

Bibl: State Mineralogist's Report XIV, pp. 433-435; State Mining Bureau Bull. 38, pp. 242-243; Bull 99, pp. 77-78.

#### CHROMITE

A little chromite had been produced in Fresno County prior to the World War, but it was only during the years 1915 to 1918, inclusive, that any considerable tonnage was produced. During this period of necessity and high prices a total of approximately 20,000 tons of chromite was produced and 10 or 12 properties were being worked. None have been active since 1918. The chrome mines and prospects are described in Bulletin No. 76 'Manganese and Chromium in California,' published by the State Mining Bureau in 1918. Most of the deposits in the Sierra were situated in and adjacent to Watts Valley and Pine Flat and on Hog Mountain, in townships 11 and 12 S., R. 24 E.

Two or three prospects were also uncovered in the Coast Range in the southwestern part of the county in T. 18 S., R. 12 and 13 E. and in T. 22 S., R. 14 E. Deposits in this county are by no means exhausted.

Bibl: State Mineralogist's Report X, p. 189; XIII, p. 49; XIV, p. 435; State Mining Bureau Bull. 38, p. 268; Bull. 76, pp. 144-146, 218-219. Mineral Resources West of the Rocky Mountains, 1868, p. 224.

#### COAL

No work has been done on the coal beds of Fresno County since 1896. The principal deposits are near Coalinga which was known for its coal deposits long before its rich oil resources were discovered. Two mines were active in the early nineties. *San Joaquin Valley Mining Company*, the main producer, was shipping in 1894 at the rate of 300 tons a month, principally to Fresno. The coal in the Coalinga field is a lignite occurring in thin beds up to a foot or two in width. The San Joaquin Valley Coal mine is in Sec. 26, T. 20 S., R. 14 E., and is owned by Edwin M. Einstein, 853 Van Ness, Fresno.

In 1925 it was reported that J. H. Tyman of Fresno had leased a coal deposit on Sec. 22 T. 20 S., R. 14 E., in this district and that mining would start at once, but nothing has been done.

Bibl: State Mineralogist's Report VII, pp. 148, 172; IX, p. 323; X, p. 186; XI, p. 217; XII, pp. 50-54; XIII, p. 53; XIV, p. 436; XVIII, pp. 152-157. U. S. Geol. Survey Bull. 398, p. 49; Mineral Resources, 1885, p. 18; 1892, p. 309.

## COPPER

The 'foothill' copper belt continues southward along the Sierra foothills bordering San Joaquin Valley on the east, from Madera County into Fresno and with more or less continuity on through Tulare County.

The only property in Fresno County which has made any noteworthy yield of copper so far is the Copper King Mine. This district made shipments amounting to 1440 tons of copper ore as early as 1865. The copper mines and prospects are described in earlier reports of the State Mineralogist listed in the bibliography and other publications of the State Mining Bureau, particularly Bulletin No. 50, 'Copper Resources of California,' 1908.

Herbert Lang gives an interesting account of the exploitation of the Fresno and Copper King Mines by the two British companies that controlled them, in an article entitled 'The Copper Belt of California,' published in Engineering and Mining Journal, issue of November 30, 1907, one paragraph of which is quoted.

"Two mines in Fresno County, the Copper King and the Fresno, have had an interesting recent history, with many aspects of which the public are familiar. Both have been in the hands of British companies, and to delineate their history for the past few years would throw much light upon the methods of British mine management and company promotion. Both these companies failed, the one temporarily, the other for all time, but I can not look upon the mines themselves as having failed in any fair sense. In neither case do I consider that they have had a fair show. It is not my intention either to extenuate or depreciate the merits of the mines of the Copper Belt; but in cases like those of the Copper King and Fresno, I consider that to allow the whole belt to rest under the imputation naturally caused by the fiasco of the former and the partial stagnation of the latter company would be unjust. I submit that a mine which, like the Copper King, contained 50,000 tons of ore having a total available content of \$20 per ton, thus aggregating a million dollars, is not an insignificant property; and, furthermore, that as such ore can be worked by economical methods so as to leave a profit of \$8 per ton, or an aggregate of \$400,000 above the original cost of the mine, works, equipment and all other expenses, it would not be a bad sort of mine to invest in for those who understood what mining really is. Rumor has it that the mine has been bottomed and pretty well worked out—but even so, the showing has not been by any means a bad one for the mine, which is small but good, and of a type with which workers along the Belt are quite familiar. It never gave warrant for the great expenditures which were made by the now defunct company, which quit without having received back a single penny of the more than £550,000 lost by it and its creditors. To all appearance the mine, when it was incorporated in London and the stock sold for £275,000, was not a whit better than several things along the Belt which then could and even now may be had for \$25,000 to \$50,000; nor did it warrant a greater expenditure for plant than such mines, which would be amply provided if they had apparatus worth \$100,000, in place of the \$700,000 that the Copper King mining and reduction works cost. With management like, let us say, that of the Campo Seco property, the whole mining and treatment cost would not have exceeded \$7 per ton; under Copper King management it reached \$26 per ton. Allowing \$7 for running costs, and \$5 more to meet the expenses of construction and maintenance, there is left \$8 per ton as profit, based on the conditions prevailing during the mine's active life."

The *Fresno Copper Mine* in Sec. 10, T. 12 S., R. 21 E., has been idle since 1908. All equipment was scrapped and sold during the war.

*Copper King Mine* in Sec. 3, T. 12 S., R. 23 E., was bought by the *Hart Copper Company* after failure of the English company and operated for a time, but the Hart Company has made no output since early in 1908. During the World War C. C. Leavitt took a lease, drew the pillars and made some production. The mine is now caved.

Farther back near the summit of the Sierras, the Minarets mineralized belt which is better known in Madera County, passes through Fresno County. Copper ore has been found in this belt on Mt. Godard at an elevation of 12,000 feet, but owing to its inaccessibility it is undeveloped.

Most of the copper-bearing ores in Fresno County also carry gold and a few properties at which there has been a little activity are described under 'Gold.'

Bibl: State Mineralogist's Report VIII, p. 209; X, p. 194; XI, p. 217; XII, p. 66; XIII, pp. 58, 59; XIV, pp. 436-438. State Mining Bureau Bull. 23, pp. 224-233; Bull. 50, pp. 277-289. Mineral Resources West of the Rocky Mountains, 1868, p. 174. Engineering and Mining Journal, Vol. LXXXIV, No. 23, November 30, 1907, pp. 1006-1010.

#### DIATOMITE

Diatomite has been generally adopted as a shorter name for both diatomaceous earth and infusorial earth, the light chalk-like siliceous



Diatomite deposit of Mineral Products Manufacturing Co., Fresno County.  
Photo by courtesy of the company.

fossil remains of microscopic plant and animal life. When pure, diatomite is usually white in color. Deposits of diatomite of more or less purity are fairly abundant in the hills bordering San Joaquin Valley on the west from San Joaquin to Kern County, but there has been little development throughout this region. Exploitation of a deposit in Fresno County, however, was begun in 1929.

*Insulator Property.* Owner, *Mineral Products Manufacturing Co., Inc.* T. H. Elliott, president; L. J. Allen, secretary. Home office: Patterson Building, Fresno. The company owns 160 acres in Sec. 8, T. 15 S., R. 12 E., covering a deposit of infusorial earth with 2,300,000 tons estimated to be exposed on the surface. The deposit is 1 mile north of Panoche Pass road and 12 miles west of Mendota, the nearest rail



shipping point. It is hauled to Mendota by truck and trailer. Activities began in 1929 and one unit of a milling plant consisting of a Williams hammer mill and two cyclone air separators has been installed. Mining is by open cut, and no drying is necessary. Two products are made and sacked; the coarser, sold under the trade name 'Insulato,' is used mainly as an insulator in walls and ceilings in building operations and for other insulation purposes, and the finer product, called 'Cementseal,' is used as an admixture in concrete. The following is an analysis by Smith Emery & Company:



Open cut in diatomite deposit of Mineral Products Mfg. Co., Fresno County.  
Photo by courtesy of the company.

#### Analysis

	Lab. No. 93437 Mark No. 1 (Dry Basis)	Insulato Lab. No. 93438 Mark No. 2 (Dry Basis)
Silica ( $\text{SiO}_2$ )-----	83.30%	72.43%
Titania ( $\text{TiO}_2$ )-----	.08%	.04%
Alumina ( $\text{Al}_2\text{O}_3$ )-----	4.94%	6.53%
Iron oxide ( $\text{Fe}_2\text{O}_3$ )-----	3.68%	8.49%
Manganese oxide ( $\text{Mn}_3\text{O}_4$ )-----	None	None
Lime ( $\text{CaO}$ )-----	.68%	.49%
Magnesia ( $\text{MgO}$ )-----	.27%	1.58%
Loss on ignition-----	5.22%	7.46%
Alkalies by difference ( $\text{Na}_2\text{O}$ )-----	1.83%	2.98%
	<hr/> 100.00%	<hr/> 100.00%

The company has also developed a special babbitting clay which is said to prevent any explosion of the hot metal when pouring. Water is

scarce at the mine but it can be developed by wells. Seven men are employed.

Bibl: State Mineralogist's Report XIV, p. 452.

#### FELDSPAR

Claims have been located for feldspar in Sec. 34, T. 11 S., R. 25 E., five miles northeast of Trimmer, but the deposit has not been developed.

*W. H. Childers*, Auberry, California, has submitted samples of good grade orthoclase feldspar from a deposit said to show eight feet in width and situated about three miles northwest of Auberry approximately in Sec. 23, T. 9 S., R. 22 E. Not enough development has been done as yet to show the extent of the deposit. Three claims have been located.

#### FULLERS EARTH

Claims have been located from time to time in the Kettleman Hills section southeast of Coalinga on deposits of a gray clay-like material reported to be fullers earth, but there has been only a very small and irregular production.

*Webb and Mingus Property.* These holdings, owned by Edward A. Webb and S. M. Mingus of Coalinga, consist of 160 acres in Sec. 20, T. 21 S., R. 17 E.; 80 acres in Sec. 28, T. 21 S., R. 17 E. and 160 acres in Sec. 26, T. 21 S., R. 17 E., a portion of the latter being in Kings County. According to the owners, tests of this material by Smith Emery & Company show it to be a good fullers earth comparable with the Florida and English earths.

Bibl: State Mineralogist's Report XIV, p. 439.

#### GEM MATERIALS

Several semi-precious gem materials have been found in Fresno County and at intervals some of it has been mined and marketed.

*Californite* occurs in small veins in serpentine on the south side of Watt Valley in Sec. 5, T. 12 S., R. 24 E. A claim was located in 1909 and some production made. Idle.

Bibl: State Mineralogist's Report XIV, p. 439; State Mining Bureau Bull. 37, p. 94; Bull. 67, p. 125; Bull. 91, p. 179. U. S. Geol. Survey Bull. 262, pp. 72-74; Min. Res. 1902, p. 747; 1911, Pt. II, p. 1044.

*Hyalite* has been found at one or two points in the high Sierras in Fresno County, but not exploited.

*Tourmaline.* Red and green tourmalines occur with quartz on White Divide, south of Mt. Godard, at an elevation of about 12,000 feet. A few stones from here have been cut for gems. Green tourmaline is also found with garnet in a white quartz ledge on Spanish Peak, in Sec. 1, T. 12 S., R. 28 E., at an elevation of 9700 feet.

Bibl: State Mineralogist's Report XIV, p. 439.

## GOLD

Fresno County owes such reputation as it has as a gold mining county mostly to early day operations in the area lying north of the San Joaquin River that was a portion of Fresno County until 1893, in which year it was separately organized as Madera County. From 80 to 90 per cent of the gold and silver output credited to Fresno County between 1880 and 1893 came from that portion, now Madera County. The amount so credited was \$1,350,000. No segregated county figures are available giving the gold production prior to 1880.

Both lode and placer mines have been worked in this county since the beginning of mining in the state. The placers were mostly superficial and were soon worked out. The most consistent producers of placer gold at the present time are the two gravel and sand plants which make a regular saving of fine gold as a by-product. As high as \$3,500 has been recovered in some months at one of the gravel plants from gravel running  $1\frac{1}{2}$  to  $2\frac{1}{2}$  cents per yard.

Owing to long periods of idleness, abandonments, relocations and renaming of many of the properties listed and described in former reports, it is not possible to give a connected account of activities. A little development work, annual assessment work and the occasional finding of a rich pocket by individuals or partners covers the present quartz mining activities.

In 1928 there were one lode operator and three placer operators, including the gravel pits, that reported production. Ten tons of ore containing 15.63 ounces of gold valued at \$323 and 732 ounces of placer gold valued at \$15,132, comprised the county's total gold production of \$15,455. Silver to the value of \$75 was also recovered with the gold.

*Eastwood Mine* is on property owned by Mrs. E. S. Eastwood, 706 Mandana Blvd., Oakland. Under lease to John W. Riffe, Star Route, Sanger, operating as the *Kings River Mining and Milling Company*. The mine is two and one-half miles northeast of Pine Flat on the road to Trimmer. There is a quartz vein here between granite and schist walls 18 inches wide on top with flat dip, about  $30^\circ$  at the surface. It gets steeper and reaches a width of 5 feet at 93 feet, the depth of the incline shaft which follows the vein. The mill, which contained a Huntington mill, plate and concentrator driven by a gasoline engine, has been partly dismantled, as it did not make a satisfactory recovery. The mine has been idle since November, 1928, but Mr. Riffe expects to resume work again. Several pockets have been taken out on the vein near the surface. Another old shaft is 100 feet north of the present one. The pay shoots appear to be short.

*Low Pocket Mine* is in Secs. 27 and 28, T. 12 S., R. 25 E. T. Pierson, Berkeley, owner. Operated by W. L. Terrill, Star Route, Sanger. A number of good pockets containing several thousand dollars have been taken from this property. Worked intermittently.

*Post Oak Mine*. Owners, W. L. Terrill and Will Stammers, Star Route, Sanger, Cal. This property which was opened up in 1927, is on the Kings River in Sec. 29, T. 12 S., R. 25 E. A mineralized zone strikes southeast-northwest in which a 'vein' with schist hanging wall, but indefinite footwall, has been drifted on 120 feet and a 40-foot winze



sunk at the end of the drift. The vein matter is about four feet in width. The ore is base containing pyrrhotite, chalcopyrite and pyrite, with some free gold. Another parallel 'vein' has been opened up by a shallow shaft and drift and a little better grade ore of similar character taken out here. The mine workings are 550 feet above Kings River and 1100 feet distant from the mill which is on a flat on the opposite side of the river. Mine and mill are connected by a single-cable aerial tram over which the ore is transported to the mill. The mill contains two stamps, plate and vanner. The ore is reported to average 10% copper and \$8 gold per ton, but the owners have had difficulty in saving the values. Operations have been intermittent.

The *White Cross*, *Dixie Queen* and *King Poulitice* owned by J. G. and D. O. Whitt of Dunlap are in Secs. 3, 4 and 10, T. 14 S., R. 26 E. These properties are equipped with small mills and have been on the producing list in recent years. Reported idle at present.



Eastwood Mine, and Mill. Kings River Mining and Milling Co., Fresno County.

Other properties whose present ownerships and activities are uncertain include:

	Sec.	Twp.	Range
Apache .....	20	12 S	24 E
Arkansas et al. ....	5	12 S	24 E
Bantam .....	24	12 S	24 E
Brushy Ridge .....	10	14 S	26 E
Contact .....	23 (?)	11 S	25 E
Davis Flat .....	1	13 S	26 E
Delilah .....	14	13 S	26 E
Dodge (placer) .....	4	7 S	25 E
Eliza Jane .....	29	12 S	24 E
Produced \$100,000 1904-1914.			
Gilroy .....	17	10 S	22 E
Independence .....	29	12 S	24 E
Jenny .....	16	13 S	27 E
John L. (Sullivan) .....	17	10 S	22 E
Paradise (placer) .....	17	12 S	25 E
Providence .....	13	10 S	25 E
Providence (Wide Awake) .....	17	10 S	22 E
Rosa .....	18	12 S	24 E

	Sec.	Twp.	Range
San Joaquin -----	17	10 S	22 E
Sunnyside -----	21	12 S	24 E

Credited with \$40,000 production to date.

H. F. Phillips, operator, R. B. Box 64, Fresno.

Bibl: State Mineralogist's Report VIII, pp. 202-216; X, pp. 183-204; XI, pp. 210-224; XII, pp. 127-131; XIII, pp. 165-171; XIV, pp. 440-451; XVII, p. 69. State Mining Bureau Bull. 92, p. 152. U. S. Geol. Survey Mineral Resources, various years.

#### GRANITE

Granites of unexcelled quality for building, ornamental and monumental work are being quarried in Fresno and adjoining counties on the north and south. Most of the 'granite' found in this area is technically 'granodiorite'; that is, both plagioclase and orthoclase



Quarry of Academy Granite Co., Clovis, Fresno County.

feldspars are present. The Fresno County stone is a dark hornblende diorite, locally called 'black granite' whose color permits of a fine contrast between polished and unpolished surfaces, making it particularly suitable for ornamental and monumental use.

*Academy Granite Company* (not incorporated). F. M. Blanchard, sole owner, Clovis, Cal. The quarry is in Sec. 13, T. 12 S., R. 22 E., half a mile from Academy and 11 miles northeast of Clovis on the Southern Pacific railroad, the nearest shipping point. It was opened up in 1903 and has been continuously active since. The stone is now being quarried from a depth of 50 to 75 feet and is in ledge form. Pneumatic tools are used, power for operating the compressor and derrick being furnished by a distillate engine. The rough blocks are hauled to Clovis by truck, dressed and polished, or sold to the trade. Some very large blocks have been taken out, the spire of the monument shown in the photo herewith weighing 12 to 15 tons in the rough. The



inished dimensions are: spire, 3' x 2'2" x 17'9"; bases, 3'8" x 2'10" x 1'4"; 5'6" x 3'8" x 1'; 7'6" x 5'8" x 10". The Academy stone has a higher specific gravity than the lighter-colored granite, such as that at Raymond, but is said to saw faster. Ten men are employed in the quarry and cutting yard.

Bibl: State Mineralogist's Report XIV, p. 465; State Mining Bureau Bull. 38, p. 26.

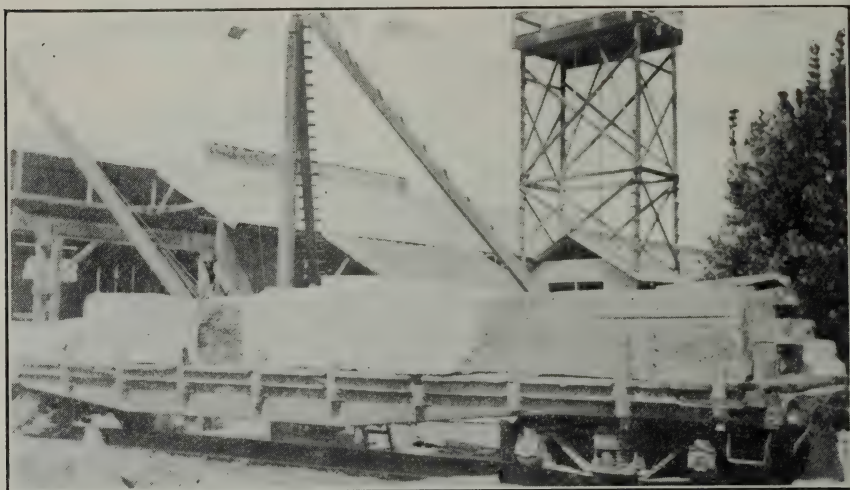


Monument of Academy Granite erected in Salt Lake City, 1924.  
Photo by courtesy of the company.

*Superior Granite Company, Inc.* N. Naggiani, president; A. Vicklund, treasurer; G. B. Ghilotti, secretary and manager. Office address: P. O. Box 68, Clovis, Cal. This company has two quarries near Academy, one of which was formerly operated by Doyle, Gill, Doyle & Co. The stone is the typical dark hornblende diorite occurring here.



The cutting yard is at Clovis and two 5-ton trucks are used to haul the rough blocks from the quarry to Clovis, a distance of 11 miles. Most of the output is used for monumental purposes but some goes into building construction. Three men are employed at the quarry and



Car of granite blocks, Superior Granite Co., Clovis, Fresno County.  
Photo by courtesy of the company.



Cutting yard, Superior Granite Co., Clovis, Fresno County.  
Photo by courtesy of the company.

sixteen in the cutting yard. Pneumatic tools operated by electric power are used.

Bibl: State Mineralogist's Report XIV, p. 467.

## GRAPHITE

Graphitic schist has been reported in Sec. 12, T. 14 S., R. 24 E., on the E. D. Kean Ranch, 4 miles east of Squaw Valley post office, and on the Ruth Ranch farther east. On Sycamore Creek, near Trimmer, there is said to be a 15-inch vein of graphite.

Bibl: State Mineralogist's Report XIII, p. 642; State Mining Bureau Bull. 38, p. 280.

## GYPSUM

Several deposits of gypsum and gypsite occur in the western portion of the county. They were discovered in the nineties and soon afterward there was a considerable output which was for the most part ground and used for agricultural purposes in Fresno and adjacent counties. No production has been reported in recent years.

*Shepherd Gypsum Deposit* (Paoli Mine). Owner, A. P. Shepherd, 3101 Mariposa Street, Fresno. This deposit is on 160 acres of patented land in Sec. 13, T. 15 S., R. 12 E. about three-quarters of a mile south of the diatomite deposit of Mineral Products Manufacturing Co., Inc. Material from here has been sold in the past to cement companies and also ground for fertilizer. Idle.

Bibl: State Mineralogist's Report XII, p. 323; XIII, p. 503; XIV, p. 452; State Mining Bureau Bull. No. 3, p. 63; Bull. 38, p. 283.

*Other Deposits* have been noted in Sec. 26, T. 20 S., R. 14 E., and in Sec. 1, T. 16 S., R. 12 E., but none are active.

## LIMESTONE AND MARBLE

Lime marl, aragonite, common limestone, crystalline calcite and marble are all found in Fresno County. Few of the deposits are of particularly notable size and with possibly one exception, they do not occur in extensive belts.

*Dr. G. T. Montford* of Coalinga owns 40 acres in Sec. 24, T. 21 S., R. 14 E., on which there is a marl deposit.

Samples of a brown aragonite from near Coalinga, which takes a good polish, have been submitted to the Division laboratory by Wm. B. Peterson, 501 Underwood Building, San Francisco.

*Webb and Mingus* of Coalinga own a deposit of calcite in Sec. 12, T. 20 S., R. 13 E., on Sherman Peak. All the above are in the Coast Range in the western portion of the county.

On the eastern side of the valley limestone occurs over a fairly large area in T. 12 S., Rs. 26, 27 and 29 E., east of Trimmer on the north side of Kings river. Undeveloped. It is found also at Sampson's Flat south of the river and north of Dunlap. Lime was at one time burned in shaft kilns near Dunlap, but there has been no activity there for twenty years.

*San Joaquin Marble Company.* A. Emory Wishon, et al. of Fresno own 125 acres in Sec. 36, T. 8 S., R. 24 E., on which there is a deposit of good quality marble showing white, blue, variegated and black

colors. It is in the form of a lens cutting across Big Creek in the granite five miles below the town of Big Creek. The marble is mainly on the south side of the creek only a few thousand feet from the San Joaquin and Eastern Railroad which terminates at Big Creek, but 500 feet lower in elevation than the tracks. Ample electric power is at hand. The lens is probably one-half mile long and at least 200 feet wide.

Bibl: State Mineralogist's Report VIII, p. 208; X, p. 185; XIII, p. 628, XIV, pp. 452, 455. State Mining Bureau Bull. 38, p. 328.



White Creek Magnesite Deposit of Webb and Mingus, Fresno County.

#### MAGNESITE

Fresno County was a small but fairly steady producer of magnesite from 1904 until 1921, the largest output being in 1917 when a little over 6000 tons, valued at \$57,422, was marketed. The properties so far developed are all situated in the vicinity of Piedra. As none are active at the present time, they were not visited. They are described



in detail by Bradley<sup>1</sup> in Bulletin No. 79 'Magnesite in California,' to which the reader is referred.

In the Coast Range *Webb and Mingus*, Coalinga, own a deposit on White Creek in Secs. 3, 4 and 5, T. 19 S., R. 13 E. Not developed.

Bibl: State Mineralogist's Report X, p. 185; XIII, p. 505; XIV, pp. 452-455; State Mining Bureau Bulletin 38, p. 328; Bull. 79, pp. 44-46. U. S. Geol. Survey Bull. 355, pp. 50-51.

#### MINERAL WATER

Fresno is generally not included when reference is made to the 'mineral spring' counties of California, yet it has a number of such springs, both hot and cold. They are situated in the western end of the county in the Coast Range, and in the eastern part, in the Sierra Nevada Mountains. Those which have been improved are patronized mainly for their medicinal qualities rather than as pleasure resorts. Most of the springs in the Sierra region are reserved by the U. S. Forest Service for public or semi-public use.

*Balsam Grove Springs.* This group of mineral springs is in Sec. 32, T. 8 S., R. 25 E., in a picturesque and heavily timbered area, there being an abundance of pine, fir, cedar and oak. Elevation 4500 feet. There are three 'iron' and one 'white sulphur' springs, all cold. It was operated for several years as a resort, under lease from the Forest Service, but is now owned by Sierra Methodist Chautauqua and Bible Conference Association, 407 Cory Building, Fresno, who acquired the property in 1917 for the Association's use.

Bibl: State Mineralogist's Report XIV, p. 456.

*Blaney Meadows Hot Springs.* A group of four small springs occurring in the canyon of the South Fork of the San Joaquin River in Secs. 14 and 15, T. 8 S., R. 28 E., about ten miles above Mono Hot Springs and four miles beyond Florence Lake. The maximum temperature of the water is 110° F., and the total flow about 40 gallons per minute. No improvements have been made as the springs are not utilized except by occasional camping parties.

Bibl: State Mineralogist's Report XIV, p. 456; U. S. Geol. Survey Water Supply Paper 338, p. 54.

A *Carbonated Spring* is at the eastern end of Fish Valley, 11 miles by trail southward from Soda Springs Flat. It is at the corner of our townships, 4 and 5 S., Rs. 26 and 27 E.

Bibl: U. S. Geol. Survey Water Supply Paper 338, p. 239.

*Coalinga Mineral Springs.* (Fresno Hot Springs). These are said to be the oldest commercially utilized mineral springs in Fresno County. The property comprises 160 acres in Sec. 34, T. 20 S., R. 13 E., and is owned by the Kreyenhagen Estate, Coalinga. For the ten years preceding 1927 the springs were closed, but they were reopened in 1927 by Coalinga Mineral Springs, Inc., P. O. Box 15, Coalinga,

<sup>1</sup>Bradley, W. W., "Magnesite in California," State Mining Bureau Bull. 79, pp. 4-46, 1925.

California, Fred C. Holland, manager. There is a total of 17 seepages and springs combined into three groups on a hillside about 100 feet above the hotel, having an estimated total flow of 600 gallons an hour. The temperatures vary from 88° to 97° F. An analysis of the water by the Twining Laboratories of Fresno shows the following constituents:

	No. 1	No. 2	No. 3
Carbonates -----	45.0	93.0	87.0
Bicarbonates -----	210.45	90.3	78.2
Chlorine -----	77.0	77.0	42.0
Sulphates (SO <sub>4</sub> ) -----	11.5	66.4	15.2
Phosphates -----	trace	trace	trace
Hydrogen sulphide -----	none	none	13.6
Arsenic -----	none	none	very faint trace
Total residue -----	50.0	504.8	419.0
Silica -----	55.0	62.6	58.6
Iron and alumina -----	0.56	5.8	1.8
Lime (CaO) -----	-----	12.6	trace
Magnesia (MgO) -----	0.78	4.5	2.0
Potassa (K <sub>2</sub> O) -----	2.0	5.6	6.4
Soda (NaO) -----	162.1	163.8	191.2
Calcium -----	2.99	-----	-----

It is highly recommended by users for its health giving qualities. Since this resort was reopened by Coalinga Mineral Springs, Inc., about \$25,000 has been spent in improvements and repairs. The bathhouse is large and modern, and the hotel will accommodate 25 to 30 people. The distance from Coalinga is 18 miles over a good road with several new concrete bridges, which follows the canyon of Hot Spring Creek for five miles after leaving the main highway between Coalinga and San Lucas.

Bibl: State Mineralogist's Report X, p. 189; XII, p. 333; XIII, 510; XIV, p. 456; U. S. Geol. Survey Bull. 32, p. 204; Water Supply Paper 338, p. 78. Anderson Winslow, 'Mineral Springs and Health Resorts of California,' 1890, p. 135.

*Coalinga Sulphur Baths.* The mineral water at these baths does not rise from a natural spring. It comes from a well which was drilled in 1906 for oil, but which obtained instead an artesian flow of hot sulphur water. The well is in Sec. 12, T. 21 S., R. 14 E., 2.7 miles southwest of Coalinga. Owner, *Santa Rosa Oil and Development Company*. Home office: First National Building, Oakland, Cal. Charles L. Smith, president; R. Whitehead, secretary. D. W. Lewis is superintendent at the property.

The well has a depth of 2077 feet and came in with an initial flow of 6000 barrels a day, but in recent years the flow has been only about 1100 barrels in 24 hours. An inflammable gas issues with the water and this is utilized for cooking. The well discharges into a concrete tank 75 feet long, 59 feet wide and 10 feet deep which serves as a reservoir head for service pipes and as a swimming pool. Forty-two dressing rooms are connected with the swimming pool. The water is piped to Coalinga and parts of the oil fields where it is used for boiler water, because it does not cause boiler-scale as is the case with most water obtainable in the area. On account of substitution of electric power for steam power at many wells in later years, the amount of water used for industrial purposes has fallen off considerably. An analysis of the water made by Smith Emery & Company of San Francisco is given below.

## Feed Water Analysis

	Grains per U. S. gallon
Analysis of solids—	
Suspended matter }	
Silica (SiO <sub>2</sub> ) }	.76
Iron oxide and alumina (R <sub>2</sub> O <sub>3</sub> )	nil
Lime (CaO)	2.61
Magnesia (MgO)	1.47
Soda (Na <sub>2</sub> O)	29.55
Sulphuric anhydride (SO <sub>3</sub> )	.81
Chlorine (Cl)	2.33
Carbon dioxide (combined CO <sub>2</sub> )	22.72
Volatile and organic matter	9.35
Total solids	69.60
Alkaline	yes
Acid	---
Hydrogen sulphide (H <sub>2</sub> S)	---
Incrusting solids—	
Suspended matter }	
Silica }	.76
Iron oxide and alumina	nil
Calcium carbonate	4.49
Calcium sulphate	.23
Calcium chloride (corrosive)	nil
Magnesium carbonate	2.75
Magnesium chloride (corrosive)	nil
Total	8.23
Non-incrusting solids—	
Sodium carbonate	46.52
Magnesium sulphate <sup>1</sup>	.45
Sodium sulphate	.68
Sodium chloride	3.85
Volatile and organic matter	9.35
Total	60.85

<sup>1</sup> Magnesium sulphate forms some scale in presence of calcium carbonate and sodium carbonate.

*Collins Spring* (Millerton Spring) is in Sec. 4, T. 11 S., R. 21 E., on San Joaquin River two miles above Friant. Elevation, 350 feet. Owners, J. D., A. S. and W. G. Collins and J. Musiek. A sulphur water spring issues from a crevice in the granite bedrock near the river's edge. The temperature is 71° F., and the flow 17,000 gallons in 24 hours. There is a little excess hydrogen sulphide gas.

The spring is walled in with a cement curb, and the water pumped into a tank from which it is drawn and heated for bathhouse use. Analysis shows 682 parts per million total solids, principally sodium and calcium chlorides, with 5.2 cc. H<sub>2</sub>S gas per liter.

This spring has been known since the placer mining days of the fifties, the ruins of old Fort Miller and the first courthouse in Fresno County at Millerton being less than a mile distant. The spring has been used as a resort since 1907. It has a 20-room hotel building and cottages, but except for new porcelain bath tubs installed in the bathhouse in 1928, replacing wooden tubs, the property has not been much improved.

Bibl: State Mineralogist's Report XIV, pp. 457-458.

*Mercey Hot Springs.* These springs form a small oasis in the nearly barren hills bordering the western side of San Joaquin Valley where



they rise at the base of a low cherty hill. The Mercey Springs property includes 160 acres in Sec. 15, T. 14 S., R. 10 E., owned by *Mercey Mineral Springs Company*. F. F. Brown, president, 810 California Building, Second and Broadway, Los Angeles. Since 1928 the resort has been under lease to W. A. Rowland, Los Banos, California. The bottling privilege is held by Mickle and Thompson; Ben C. Mickle, Mills Building, San Francisco. The water is bottled at the spring and hauled by trucks to San Francisco and marketed.

The springs are situated near the extreme northwestern corner of the county near the head of Little Panoche Creek at an elevation of 1200 feet. The principal spring has a flow of 18,000 gallons in 24 hours, and a temperature as it issues of 120° F. Another spring which is small and highly sulphurated is not used. These springs have been known since 1848, having been used in the early days for watering sheep. They have been utilized as a health resort for the past thirty years, the water being highly recommended in the treatment of rheumatism, gout, diabetes, dyspepsia, nervous disorders and anemia. The hotel, bathhouse and electric light plant, with which they were equipped, burned in August, 1927, since which time accommodations for guests have been somewhat curtailed but 35 to 40 can be taken care of at present in the main building and cottages, and there is a camp ground as well. The road is good from Los Banos or Firebaugh on the east, or from Hollister on the west by turning off two miles beyond Llanada.

The following is an analysis of Mercey water by Marvin Curtis, authority, advertising matter:

	Grains per Gal.	Parts per 1000
Boric acid (Anhydrous) -----	.093	.016
Sodium chloride -----	117.428	20.104
Sodium sulphate -----	.169	.029
Sodium carbonate -----	2.105	.360
Potassium sulphate -----	.771	.132
Calcium chloride -----	4.994	.855
Magnesium chloride -----	.240	.041
Iron carbonate -----	trace	trace
Calcium phosphate -----	.460	.079
Calcium carbonate -----	.654	.112
Calcium sulphate -----	.245	.042
Magnesium carbonate -----	.707	.121
Silica -----	4.089	.700
Total -----	131.955	22.591

Lithium—Well marked test.

Barium—Faint reaction.

Strontium—Faint reaction.

*Mono Hot Springs* (Lower Mineral Hot Springs). These springs are on the South Fork of San Joaquin River in Sec. 16, T. 7 S., R. 27 E. There are six springs, the hottest having a temperature of 112° F. The meadow containing this group was formerly leased to private parties by the Forest Service, but it is now known as Lower Mineral Public Camp. Improvements consist of five baths. The road from Huntington Lake to Florence Lake passes the camp.

Bibl: State Mineralogist's Report XIV, p. 457. U. S. Geol. Survey Water Supply Paper 338, p. 55.

Another *Sulphur Spring* is located in Sec. 19, T. 9 S., R. 25 E., in Sulphur Meadows near Shaver.

*Three Springs* are in a small meadow on the high slope of the Sierras between two branches of Rancheria Creek in Sec. 20, T. 11 S., R. 28 E. and are reached by trail from Dinkey Creek Ranger Station. These three large springs have a fine flow of clear cold water. No improvements.

Bibl: State Mineralogist's Report XIV, p. 459. U. S. Geol. Survey Water Supply Paper 338, p. 338.

*Trimmer Springs* consist of four cold springs yielding iron, magnesia and sulphur water. They are situated in Sec. 18, T. 12 S., R. 25 E., on Kings River, 14 miles above Piedra and three-quarters of a mile south of Trimmer post office. They have not been operated as a resort since 1911.

#### NATURAL GAS

There is more or less natural gas in nearly all the oil wells in the Coalinga field. Commercial production in Fresno County in 1927 was 682,652 M. cu. ft. valued at \$148,227.

Bibl: State Mineralogist's Report VII, p. 65; X, p. 189; XI, p. 210; XII, p. 348; XIII, p. 567; XIV, p. 461. State Mining Bureau Bull. 3, p. 20; Bull. 19, p. 183; Bull. 69. U. S. Bur. of Mines Bull. 19, p. 88. (See also petroleum.)

#### PETROLEUM

Fresno County owes its high rank as a mineral producer in great measure to the oil wells of the Coalinga field. Of a total recorded mineral output valued at \$242,071,804 from 1880 to 1927, inclusive, the sum of \$225,070,811, or approximately 94% is accounted for by petroleum, the production of which in appreciable amount did not begin until 1896. The output of this field has been over 310,000,000 barrels. In 1927 there were 973 producing wells and proved oil land amounted to 14,665 acres. Fresno county at one time ranked first in petroleum output, but it now ranks fifth being exceeded by Los Angeles, Kern, Orange and Ventura counties. The 1927 yield was 2,202,284 barrels, valued at \$5,977,176.

The Coalinga field has been described in many state and federal reports and bulletins and in technical journals devoted to the oil industry. Current operations are published in 'Summary of Operations, California Oil Fields' issued by the State Division of Oil and Gas.

Bibl: State Mineralogist's Report VII, p. 65; X, p. 189; XII, p. 352; XIII, p. 571; XIV, p. 461. State Mining Bureau Bull. 3, 15, 19, 31, 32, 69, 89. Annual Reports of the State Oil and Gas Supervisor, Vols. I to XIII, 1915-1928. U. S. Geol. Survey Bull. 213, 357, 398, 603.

#### PUMICITE

An extensive deposit of a smooth, soft, pulverulent cream-colored pumicite or volcanic ash occurs on both sides of San Joaquin River from 1 to 3 miles north and northeast of Friant, mainly in T. 11 S., R. 21 E.

This material was first mined in a small way on the Madera County side about 25 years ago and utilized as a polish. Again in 1914 a small plant was established in Fresno, which made a polishing powder and scouring soap, but activities were short lived.

During the past year development of this deposit south of the river (Fresno County) on the Fort Miller Ranch of 7500 acres owned by the McKenzie Estate, Fresno, has resulted in a considerable output



Pulverizing mill, with tunnel in deposit showing in background. Fort Miller Pumicite Deposit, Fresno County.

which was utilized as an admixture with cement in concrete. The results of research and testing of this Fresno pumicite for such use indicates that it has very valuable qualities that will doubtless result in an important nonmetallic mining industry here.

A very interesting article by J. B. Lippincott<sup>1</sup> relative to the use of such volcanic materials with cement, and containing data covering preliminary tests with Fresno pumicite was recently published in Western Construction News.<sup>2</sup> It is believed the following liberal extract from the above paper will prove of interest:

In Rock Products for September 29, 1928, there is a series of articles relative to the use of volcanic tufas, that are known in Italy as pozzolanas, in Germany as trass, and in America sometimes called tufas and sometimes pumicite. These resemble each other chemically. These articles show that the blending of these volcanic properties with cement permit of obtaining an improved concrete.

Pumicite has been defined by Dr. E. Lee Heidenreich as "finely divided powder or dust made up of small sharp angular grains of volcanic glass." According to Robt W. Hunt Co., testing engineers, San Francisco, the chemical analysis of Fresno pumicite is as given in the following table:

Analysis of Fresno Pumicite	
Analysis of Moisture-free sample	
Silica ( $\text{SiO}_2$ )	73.18%
Iron oxide ( $\text{Fe}_2\text{O}_3$ )	1.09%
Alumina ( $\text{Al}_2\text{O}_3$ )	15.46%

<sup>1</sup> Consulting Engineer, Los Angeles.

<sup>2</sup> Lippincott, J. B., Blending Fresno Pumicite with Cement, Western Construction News, San Francisco, Cal. Vol. IV, No. 9, May 10, 1929, pp. 243-246.



Lime (CaO) -----	1.37%
Magnesia (MgO) -----	0.36%
Sulphuric anhydride (SO <sub>3</sub> ) -----	0.71%
Loss of ignition -----	4.17%
Alkalies and undetermined -----	3.66%
Moisture at 105° C. -----	0.33%

Dr. William Michaelis in Berlin in 1895, in his 'Behavior of Hydraulic Cements in Sea Water,' stated: "It is easily understood that a body in which so considerable a quantity of active lime becomes liberated can not be, in the chemical sense, a stable compound. The free lime must work and react until, in one way or another, it forms a saturated compound. This occurs first from the surface downward, by the absorption of carbonic acid, when the cement is exposed to the air or to water containing carbonic acid; and after such a consideration it may be concluded a priori that if there is offered to the lime, while it is in process of separating out, pozzolanas (such substances which, in combination with calcium hydrate, form cement) the amount of effective cement in the mortar may be increased in such a way that no more caustic lime can be deposited in crystals, but that the entire quantity of calcium hydrate is employed in the formation of calcium hydrosilicate and aluminate."

In 1906, Bertram Blount, F.C.S., read a paper on cement manufacture in which he stated: "Most limes and cements are liable to show deterioration after reaching their maximum tests, but when trass is used as an admixture this does not occur. Trass is invaluable to rectify the dangers of portland cement which contains an excess of free lime, as also to secure a perfect quality in the standard of portland cement."

Prof. Dr. Ing. A. Kleinogel states in 'Einflüsse auf Beton, 1925' p. 156: "To prevent deterioration of cement and concrete due to injurious chemical action in ground water, it is always recommendable to use a dense mixture with trass as admixture, and further to protect the surface by bituminous paint."

When used with cement concrete, the admixture of trass has the effect of strengthening the mix and causes it to assume a condition of induration in the center with equal rapidity to the surfaces, which are exposed to the action of the atmosphere, thus preventing superficial fractures by expanding and shrinking movements, caused by the lime particles striving for combination with carbonic acid from the atmosphere.

In the summary of 'British Research on Lime and Mortars' we further find: "As a matter of fact, it has been observed that concrete floor, wall, and pier surfaces, as well as pavements, in which pumicite has been incorporated, have been noticeably free from hair cracks, crazing, or even through cracks."



Earlonte Mining Co's. tunnel entry, Fort Miller Pumicite Deposit, Fresno County.

It is stated that pumicite combines with the free lime in the cement, forming insoluble compounds of cementaceous value. It also aids in carrying the gradation of the aggregates one step further because of its fineness. Both of these characteristics produce greater strength and density of concrete where added in proper ratio.

A series of tests was made by the Robt. W. Hunt Co. of this Fresno pumicite, blended in various proportions by weight with standard cements, for time of setting and also for fineness of the pumicite. It is shown below that the blended cement concretes are slower in reaching their strengths than in cases where straight cements are used. The pumicite compounds continue to increase in strength for more than a year. The Hunt report states:

"We give you the following results of a series of tests made on mortar cylinders and briquettes made up in the proportion of one part cement to three parts standard

Ottawa sand, the cement portion containing various proportions by weight of an inert compound labeled 'Pumicite' submitted to us:

Tests will be designated as follows, for identification:

Set O—1 part cement (100% cement—No pumicite) to 3 parts Ottawa sand
Set A—1 part cement ( 95% cement— 5% pumicite) to 3 parts Ottawa sand
Set B—1 part cement ( 90% cement—10% pumicite) to 3 parts Ottawa sand
Set C—1 part cement ( 85% cement—15% pumicite) to 3 parts Ottawa sand
Set D—1 part cement ( 80% cement—20% pumicite) to 3 parts Ottawa sand
Set E—1 part cement ( 75% cement—25% pumicite) to 3 parts Ottawa sand
Set F—1 part cement ( 70% cement—30% pumicite) to 3 parts Ottawa sand

*Normal Consistence*: Per cent water by weight required for a Vicat penetration of 10 m.m. in 30 seconds, on cement mixture.

Water for mortar mix was based on Vicat penetration of cement mixture.

*Setting Time*: Initial and Final sets determined by Gillmore needles.

#### Laboratory Data

Set	Per cent Water for Neats	Per cent Water for Mortar	Soundness Test	Setting Time	
				Initial	Final
O	23.0	10.30	Satis.	3 hr. 25 min.	7 hr. 50 min.
A	24.0	10.50	Satis.	3 hr. 25 min.	8 hr. 10 min.
B	25.0	10.67	Satis.	3 hr. 50 min.	8 hr. 50 min.
C	26.0	10.83	Satis.	3 hr. 55 min.	9 hr. 10 min.
D	27.5	11.10	Satis.	4 hr. 40 min.	9 hr. 10 min.
E	28.5	11.25	Satis.	4 hr. 40 min.	9 hr. 30 min.
F	30.0	11.50	Satis.	4 hr. 50 min.	9 hr. 45 min.

Pumicite

alone 47.0

14.30 No hydraulic properties

*Tensile Strength*: Lb. per sq. in. at 28 days. (Mortar briquettes stored 24 hours in moist air at 70° F. and 27 days in water at 70° F.)

		Per cent Standard Strength
Set O—440-420-420-435—Average	438	100.0
Set A—425-420-430-420—Average	424	96.8
Set B—405-415-415-405—Average	410	93.6
Set C—395-415-405-415—Average	407	92.9
Set D—390-400-400-395—Average	396	90.4
Set E—385-400-395-400—Average	395	90.2
Set F—385-395-380-375—Average	384	87.7

*Compression Strength*: Lb. per sq. in., at 28 days. (Mortar cylinders 2½ in. diam. by 4 in. high, stored 28 days in damp sand.)

		Per cent Standard Strength
Set O—3284-3345-3253—Average	3294	100.0
Set A—2878-2925-2824—Average	2876	87.3
Set B—2658-2741-2729—Average	2709	82.2
Set C—2660-2621-2662—Average	2648	80.4
Set D—2565-2515-2559—Average	2546	77.3
Set E—2116-2029-2027—Average	2057	62.4
Set F—1644-1520-1534—Average	1566	47.5

#### 90-day Tensile Tests on Pumicite Briquettes

For description of mix, see Robt. W. Hunt Co., Report No. 26246 dated Sept. 14, 1927.

*Tensile Strength*: Lb. per sq. in. at 90 days.

		Per cent Standard Strength
Set O—420-420-420-440—Average	425	100.0
Set A—535-535-550-535—Average	539	126.8
Set B—530-520-530-500—Average	516	121.4
Set C—530-490-500-510—Average	507	119.3
Set D—505-485-475-475—Average	485	114.1
Set E—490-490-465-460—Average	471	110.8
Set F—470-460-485-460—Average	469	110.4

#### Sieve Analysis of Pumicite:

Passing No. 100 sieve—99.1%
Passing No. 200 sieve—97.2% (dry sieving with shot)
Passing No. 200 sieve—99.5% (by washing through)

The tensile strengths at the end of 90 days are greater for all the blends in this series of tests of pumicite with cement than those made of pure cement. The briquettes were made on a ratio of 3 parts of sand to one part of straight cement and of different blends shown. The increase of tensile strength with age is more pronounced with the blends than with the pure cements.

In the compression tests for 28 days the straight cement cylinders show the greater strength. The characteristics of the pumicite blends are that they continue to increase in strength with age a longer time than the concretes made from straight

cements, as indicated by the tension tests. These 28-day compression tests are not conclusive.

A series of compression tests lately made at the laboratory at the Pardee reservoir by Lewis H. Tuthill, concrete technologist for the East Bay Municipal Utilities District, using the aggregates that were going into the dam and tunnel and Fresno pumicite, are as follows:

**Effect on Compressive Strength at Various Intervals of Substituting  
Pumicite for Cement by Volume**

Per cent Pumicite	Actual Cement bbl./c.y.	Actual Water Cem. R.†	Slump	Fineness Modulus	Strength 28 da.*	Strength 3 mo.*	Strength 6 mo.*
None -----	0.94	1.09	6-8	6.57	1455 1.00	1600 1.10	1775 1.22
10 -----	0.85	1.13	6-8	6.57	1302 1.00	1679 1.29	1867 1.43
20 -----	0.76	1.16	6-8	6.57	1098 1.00	1469 1.34	1713 1.56
30 -----	0.67	1.19	6-8	6.57	996 1.00	1477 1.48	1772 1.78

† In addition to water here indicated, water was added for absorption of the aggregates and an amount equivalent to 60% of the weight of the pumicite.

\* Each strength value is the average of two 8 by 16-in. specimens, each from a different batch assembly. One specimen for each period was made from each batch.

NOTE.—It was plainly noticeable, particularly in this wet consistence, that as the amount of pumicite substituted increased, the mixture became harsher as to workability. This is believed to be due to the lower absolute volume and mass in an equivalent volume compared with cement which reduces the lubrication. In order that workability be maintained, particularly where the remaining cement is less than 1 bbl. per cubic yard, substitution by weight is recommended.

Another series of tests was made with Fresno pumicite at the same laboratory in which the maximum size of the stone was  $1\frac{1}{2}$  in., 1.19 bbl. of cement being used per cubic yard.

**Tunnel Concrete**

	Pounds
1. Standard cement alone	28 days 2347 3 mo. 2515 6 mo. 2710
2. Substituting 10% by volume of cement with pumicite	28 days 1676 3 mo. 2295 6 mo. 2368
3. Substituting 20% by volume of cement with pumicite	28 days 1379 3 mo. 2142 6 mo. 2344
4. Substituting 30% by volume of cement with pumicite	28 days 1183 3 mo. 2020 6 mo. 2456

NOTE.—1 cu. ft. of pumicite weighs 57 lb.

It will be noted that where smaller percentages of pumicite were used, they attain earlier relative strength, but at the end of six months the 30% substitution gave the greater strength of any of the blends. This 30% blend gave 90.5% of the straight cement cylinder. Probably at the end of a year it would fully equal it, as this sample gained 22.5% from 3 to 6 months.

The engineers of the Fresno Irrigation District have been adding this pumicite to concrete for the past two years, because of the improved workability and density obtained due to such addition. It is said that Fresno pumicite is now also adopted for concrete mixtures on the Turlock, Modesto, Consolidated, and Alta districts. From 15 to 25% by volume of substitution is used.

The following tests of this pumicite have been made for the Fresno district by the Twining Laboratories of Fresno, under date of January 9, 1929:

The aggregates are the same in each instance, except that pumicite has been added to the cement as indicated. One part of cement was used to 7 parts of aggregates. It is the practice to put the pumicite in the mixer with the cement and water, and turn it over from one to two minutes before adding the other aggregates.

Sixty-day tests of concrete made with straight cement and also Fresno pumicite added in percentage of cement as stated.

	Compression Pounds per sq. in.	
	28 days	60 days
3. Straight cement -----	1070	1490
4. Straight cement -----	1296	1520
7. Cement plus 10% by volume of pumicite -----	1351	1780
8. Cement plus 10% by volume of pumicite -----	1444	1700
11. Cement plus 20% by volume of pumicite -----	1444	1970
12. Cement plus 20% by volume of pumicite -----	1648	2140
15. Cement plus 30% by volume of pumicite -----	2000	2460
16. Cement plus 30% by volume of pumicite -----	1481	2720
19. Cement plus 40% by volume of pumicite -----	1833	2850
20. Cement plus 40% by volume of pumicite -----	2014	2720



In every test but one, greater strength was obtained from the pumicite blends. These were field tests where the blend was made in the mixers.

The manufacturers of concrete pipe in Fresno and the vicinity have, during the last year, generally added 20 to 25% by volume of pumicite to their mixtures, because of the improved workability of the resulting mortars and the increased density and strength of the pipe that is made with the blended material. The average breaking test with standard 8-in. concrete pipe so made, is said to be 85 lb. hydrostatic test.

In the construction of the Los Angeles aqueduct, a pumice rock locally known as 'tufa,' but chemically resembling pumicite, was manufactured and used for lining approximately 100 miles of the conduit. The practice was to blend equal parts of cement and tufa by volume. The details of this manufacture and many tests are given by the writer in the Transactions of the American Society of Civil Engineers, Vol. LXXVI, page 520. This tufa, however, was in the form of a vesicular rock, which had to be crushed and ground in tube mills with the cement for the purpose of blending. Eighty-four per cent of the blended product passed a 200-mesh screen. The tensile strength of this product was much the same as straight cement. Its use accomplished a substantial saving in cost.

There were two deposits of tufa used for this blending with Monolith cement, one at Fairmount and one at Haiwee. These two deposits were quite similar. The analysis of Fairmount raw tufa was:

SiO <sub>2</sub>	72.5
Fe <sub>2</sub> O <sub>3</sub> }	
Al <sub>2</sub> O <sub>3</sub> }	15.3
CaO	trace
MgO	trace
SO <sub>3</sub>	trace
Loss	4.3
K <sub>2</sub> O	2.28
Na <sub>2</sub> O	2.68

The following long-time tests were made with the blended products:

Average of 30 breaks of blended Monolith cement and Fairmount tufas, blends 50% by volume, one part blended cement to three parts Ottawa sand.

	Pounds
3 days -----	152.0
7 days -----	248.5
28 days -----	421.2
3 months -----	491.0
6 months -----	538.1
1 year -----	546.0
5 years -----	643.2

Average of 10 tests of Monolith cement blended with Haiwee tufa, blend 50% by volume, one part blended cement to three parts of Ottawa sand.

	Pounds
3 days -----	129.5
7 days -----	168.0
28 days -----	342.5
3 months -----	449.0
6 months -----	486.5
3 years -----	524.0

The continued growth in strength with age up to the 5-year maximum age of the briquettes is of especial interest. The writer is not familiar with tests showing corresponding increase in strength through so long a time on the part of straight cements.

Pumicite is now being extensively mined in Kansas and used successfully in blending with cements for structural reinforced concrete work. It is claimed to produce a more uniform concrete. The old Roman concretes were made by mixing volcanic ash and lime for the cementing properties.

The subject of the possibilities of the blending of the Fresno pumicite with cement in the making of concrete is now being more extensively investigated by several competent authorities. The above data are preliminary memoranda of tests bearing on this subject.

Based largely on an experience with the use of the tufas on the Los Angeles aqueduct, the writer believes that cements may be blended with these volcanic products in such a way as to obtain improved results and with economy. The experiments carried on by the city of Los Angeles with these products, indicate that the strength of the concretes and mortars continues to increase for a period of five years, which was the limit of the age of the samples tested. The Fresno pumicite is unique on account of its extreme fineness and uniformity, which should give to it greater cementaceous properties than the coarser materials of the same chemical properties. Because of the geographic location of the deposit and the qualities shown above, it is a distinct asset to the mineral resources of the state.

*Earlonte Mining Company.* L. T. and E. A. Bennett, Box 474, Selma, Cal., operating under the above name began mining pumicite at the Fort Miller Ranch deposit early in 1928. They have a lease from

the McKenzie Estate, and are mining on a royalty basis on the opposite side of a hill from McKenzie's workings. The entire hill is apparently pumicite with a thin overburden of about two feet of soil. The exact depth of the deposit at this point is not known but it is said to be from 40 to 50 feet thick. Mining so far has been by running drifts in the bed, the material being consolidated enough to stand up without timbers. Pillars are left to support the roof. It can be picked down or bored with augers. If worked by open cut, it could be readily mined by a power shovel. The company has a small milling plant of very simple construction as the pumicite is easily broken down to a fine powder. This plant consists of a hopper feeding a toothed threshing-machine cylinder driven at fairly high speed by a small gasoline engine. The pulverized material falls into a bin from which it is drawn and sacked by hand. Further information is contained in the introductory matter. The deposit is within 3 miles of the Friant branch of the Southern Pacific and only 23 miles from Fresno. Two men are employed intermittently.

*Fort Miller Pumicite Deposit.* The McKenzie Estate, A. H. McKenzie, Griffith-McKenzie Building, Fresno, owners. On this property, which contains 7500 acres, the owners are also mining the pumicite on the opposite side of a hill from the workings of Earlonite Mining Company. A pulverizing mill similar to that described above is used. The pulverized material is sacked and hauled out by truck. Mining has been carried on at intervals since 1927. Additional details concerning this deposit and its uses are given in the introduction.

#### QUICKSILVER

In the earlier reports and bulletins of the State Mining Bureau the mines in the New Idria district are described as being in Fresno County; but in 1888 the county boundary was changed so that New Idria is now in San Benito County. Excluding the New Idria district, there was no recorded production of quicksilver in Fresno County until 1912. During several years since then there has been a small and irregular output varying from 1 to a maximum of 375 flasks. The quicksilver producing area lies in the Coast Range in the extreme western end of the county.

The mines as of 1918 are described in detail in Bulletin No. 78. The following notes will serve to bring that report up to date.

*Archer Mine.* Joseph Byles & Sons, Coalinga, owners. These claims, which were located in 1904, are in Secs. 2 and 3, T. 18 S., R. 13 E., 28 miles northwest of Coalinga. A Johnson-McKay retort is at the mine. Three men were working recently. A small output was made in 1928.

*Hollister Group,* consists of 5 claims: the Buena Vista, Croxton, Providential, Stevenson and Gabilan, situated in Sec. 8, T. 13 S., R. 10 E., about 23 miles from South Dos Palos or Mendota. The group has been held since 1902. Owners: Bert Johnson, J. J. Croxton, Thos. Flint, Mrs. Gail Briggs and Anna E. Stevenson, all of Hollister. The claims adjoin and lie on the hills above the Mercey Mines group. Most of the work has been done on the Buena Vista and Providential

claims. The country rock is a metamorphic sandstone. Three strong quartz veins cut through the district, and although appearing barren to the eye, the quartz will pan well in places. Cinnabar also occurs in more or less parallel mineralized zones in the decomposed and ochereous sandstone. Samples every 2 feet, taken over a width of 20 feet, where three men were doing assessment work, all panned well,



Scott furnace at Mercey Mines, Fresno County.

but in other places the mineralized zones are much narrower, being only 3 to 6 feet in width. The character of the ore makes it difficult to distinguish barren material from cinnabar-bearing rock except by testing; and pannings can be obtained in so many scattered cuts and openings that the most advantageous point at which to develop the deposit is uncertain.

*Idart Prospect.* This prospect is on the Charles Idart ranch one-half mile north of the Hollister Group and Mercey Mines. It was discovered by L. B. Chenoweth and extends the known mineralized area to three-quarters of a mile in length, north and south.

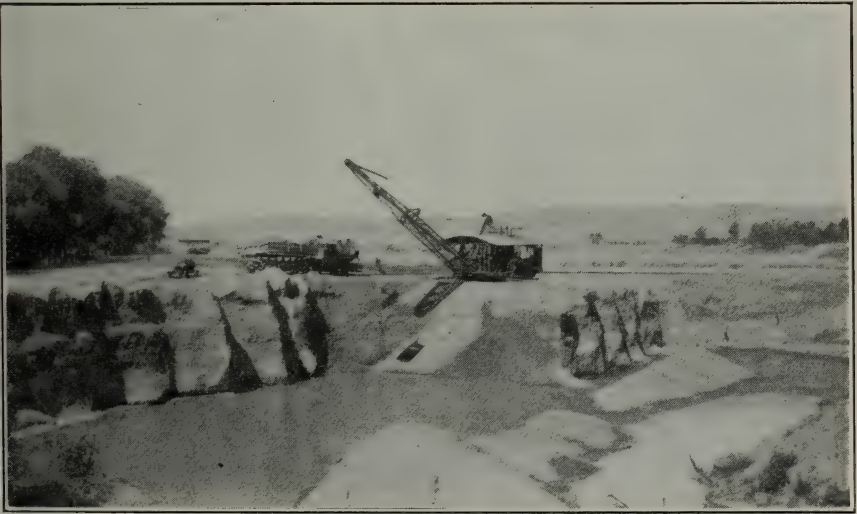
*Mercey Mines.* This group is centered about the old patented Arambide and Aurecochea claims worked in the sixties by Mexicans. When



operated by *Pacific Quicksilver Company*, 1911 to 1914, some 18 claims and 5 millsites were included; part of these claims now form the Hollister Group.

*Pacific Quicksilver Company* quit in 1914 just prior to the high prices quoted for quicksilver during the war. The property was idle until 1917 when *New Mercey Mining and Development Company* (formerly *Mercey Mining and Development Company*) started work, but little was accomplished. A homemade concentrating plant was started but did not prove successful.

L. B. Chenoweth, address: South Dos Palos, has been in charge of the property in recent years and has located or relocated some of the claims. Chenoweth has done considerable surface work in tracing out the mineralized zones and exposing new discoveries. The old workings on the Arambide, which are partly open cut, are said to show 12,000 tons of ore in sight, valued at present price of quicksilver, at \$50 a ton. The property is equipped with a 24-ton Scott fine-ore furnace but all machinery and equipment is now in a dilapidated condition. Mercey Mines and the Hollister Group could be best worked as one property. Mercey Mines and all equipment was sold under foreclosure of a deed of trust in March, 1929, and purchased by A. F. Biaggi, of San Jose, Cal., L. B. Chenoweth remaining as caretaker.



Monighan dragline excavator at Grant Rock and Gravel Company's Pit, Fresno County.

Bibl. State Mineralogist's Report XIV, pp. 462-464; State Mining Bureau Bull. 27, pp. 119, 121; Bull. 78, pp. 43-46. U. S. Geol. Survey Mon. XIII, p. 380; Min. Res. 1912 Pt. I, p. 939; 1913, Pt. I, p. 204.

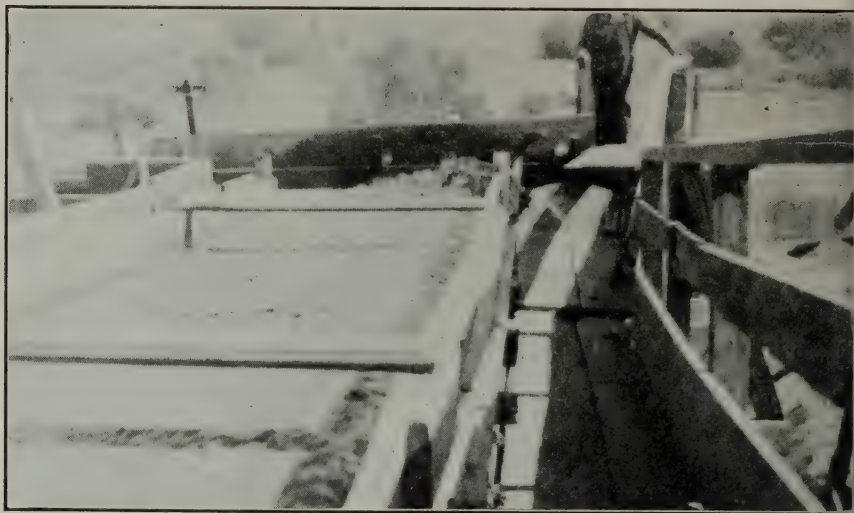
*Mexican Mine*, is in Sec. 22, T. 18 S., R. 13 E., 9 miles southeast of New Idria. Owned by Antonio Urrutia et al. of Panoche. Idle.

## STONE INDUSTRY

*Fresno Rock Products Company* formerly had a gravel plant on Kings River at Woodrock four miles below Piedra. Operation began in 1917 and continued until 1927 when the company quit. The plant has since been sold and torn down.

Bibl: State Mineralogist's Report XVII, p. 70.

*Grant Rock and Gravel Company.* H. M. Estes, president; W. S. Wilsey, secretary. Home office: Cory Building, Fresno. This com-

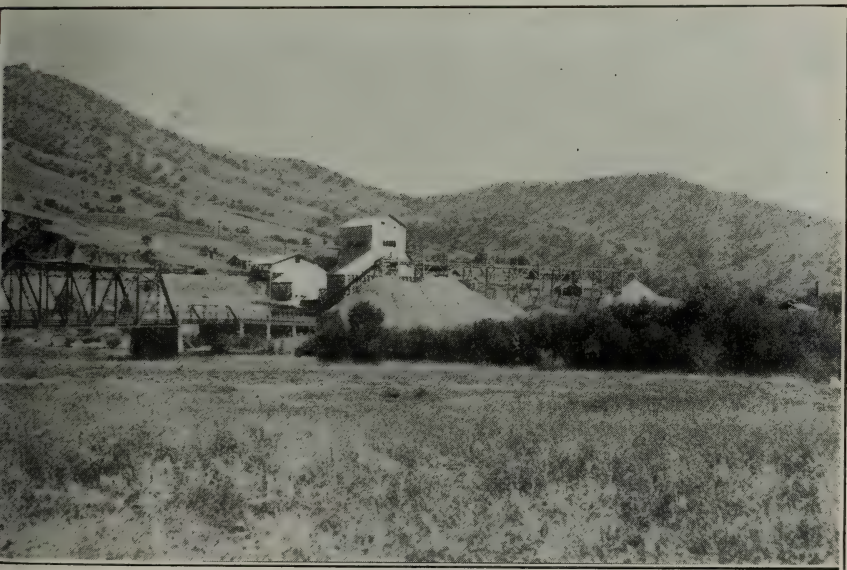


Rifle box for recovery of gold from washed sand at Grant Rock and Gravel Company's Plant, Fresno County.

pany is a producer of crushed rock (river gravel), sand and gravel. It was organized in 1915 and bought the gravel pit previously owned by Wishon and Durfy of Fresno and operated by *San Joaquin Rock and Gravel Company*. The property is in Sec. 18, T. 11 S., R. 21 E., about one mile southwest of Friant and served by a spur track from the Southern Pacific railroad. It covers a deposit of old river channel gravel and sand, which is dug to a depth of 25 feet by a Monighan 2½-yd. dragline. Total depth to bedrock, 90 feet. The dragline loads to 20-yd. cars which are hauled to the plant by an American saddleback locomotive. The material is dumped over a coarse grizzly into a hopper from which it is taken by belt conveyer through a concrete-lined open tunnel to the primary crusher, a 13 by 24-inch jaw crusher. This is followed by a scalping screen. Symons disc crusher and a series of sizing screens. All gravel and boulders over 2-2½ inches in diameter are crushed, forming the crushed rock product, while the minus 2 to 2½-inch gravel and sand is simply washed and screened to different sizes. Either the crushed or uncrushed material is supplied in various sizes, 2, 1, and ¼-inch and sand. The bunkers load direct to railroad cars. A Brownhoist locomotive crane is used in the yard to load from stock piles. The gravel here

carries from 2 to 2½ cents per yard in gold which is recovered in the washing operation by the use of Hungarian riffles in the discharge box. Electric power is used in the plant, and Diesel and steam power for the rolling-stock. The capacity of the plant is from 1000 to 1500 tons a day. As a number of additions have been made to the original plant from time to time, it is not of strictly modern design and the erection of an entirely new plant is contemplated. Twenty-five men are employed. Harry Frost, superintendent.

*Piedra Rock Company's Quarry.* Operating company *Coast Rock and Gravel Company*, 1000 Hunter-Dulin Building, San Francisco. Emery Oliver, president; F. W. Erlin, vice president and general manager; C. A. Roller, secretary-treasurer. The property includes over 300 acres in Sec. 8, T. 13 S., R. 24 E., on Kings River at Piedra, the terminus of the Santa Fe branch line from Reedley. The quarry was originally opened up by the railroad company in 1910, but has been worked since by various lessees and the Piedra Rock Company, owners. Operation of the quarry was assumed by the Coast Rock and Gravel Company in January, 1921.



Crushing and screening plant at Piedra Rock Company's Quarry, Piedra, Fresno County. Photo by courtesy of the company.

The rock is a fine-grained blue-black basalt or 'trap' rock. At the present time the quarry face is approximately 150 feet high and 2000 feet long. The rock is broken down by bank blasting. Holes are put down by well drill. A recent blast broke down 1,000,000 tons or 750,000 cu. yds. of rock. The explosive was placed in 32 holes, 160 feet deep and spaced 40 feet apart. The broken rock is loaded into 6-yd. dump cars by a 2-yd. Bucyrus 50-B, electric shovel mounted on caterpillar trucks. This shovel has replaced two others formerly used which operated on rails. Cars from the quarry dump direct to



the primary crusher, a No. 10 gyratory. The discharge goes to a scalping screen and oversize from the screen to two No. 6 gyratory secondary crushers. After passing these the rock joins the undersize from the first scalping screen and all goes to the reduction crushers consisting of one Symons disc and one pair of 24 by 36-inch rolls. These are followed by the sizing screens which discharge into bunkers. From the bunkers the crushed rock is drawn into railroad cars or goes to yard storage. A Brownhoist locomotive crane with 2½-yd

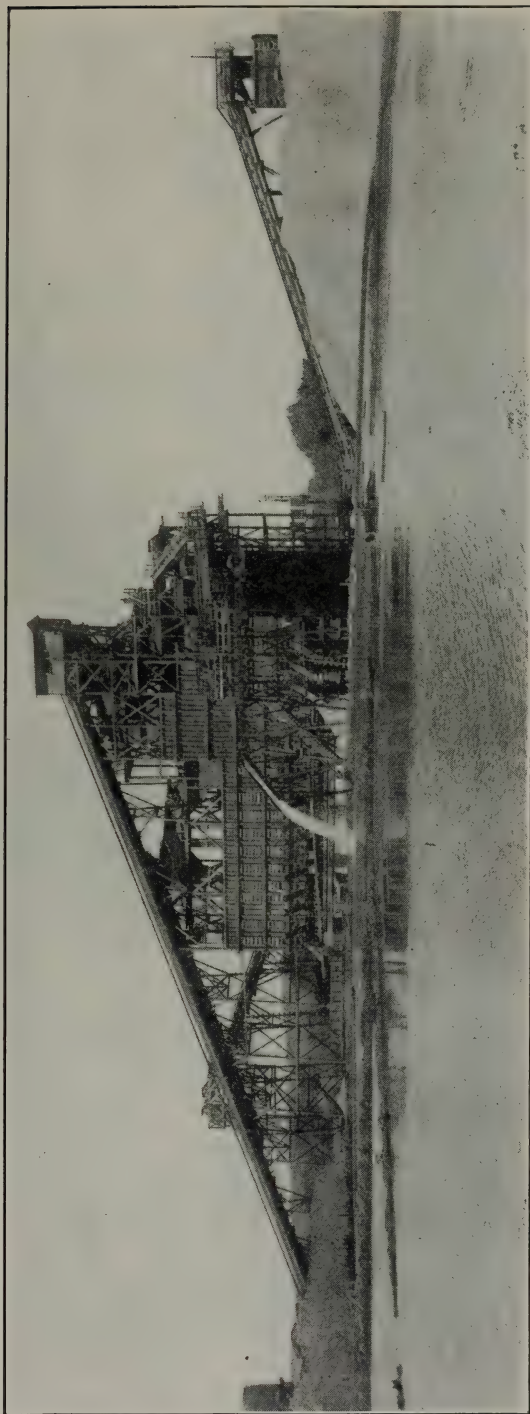


Finish of blast; 4 well holes, 40 feet apart and 55 feet from face, at toe. Approximately 6 tons of explosive used. Piedra Rock Company's Quarry, Fresno County. Photo by courtesy of the company.

bucket is used in the yard. Sizes produced are 2½ to 1-in., 2 to 1-in. 1 to ½-in., ½ to ¼-in., ¾ to ⅛-in., and ⅜-in. to dust.

The capacity of the plant is 2000 tons a day. Electric power is used totaling about 250 horsepower. Twenty-five men are employed.

*Service Rock Company* (gravel pit). This company started operations in 1924 and has the most modern gravel plant in the county. J. D. Patterson, president; B. H. Nelson, secretary. Home office: 420



Service Rock Company's Plant at Rockfield, Fresno County. Photo by courtesy of the company.

Patterson Building, Fresno. The property consists of 600 acres situated in Sec. 36, T. 11 S., R. 20 E., 4 miles below Friant and 16 miles from Fresno, covering a deposit of sand and gravel in an old channel of San Joaquin river about a quarter of a mile from the present channel. A spur of the Southern Pacific railroad has been built to the plant, the local station being called Rockfield. The deposit runs about 25% sand and 75% gravel. It is dug to a depth of 40 feet, which is about 30 feet below ground water level, by a 5-cu. yd. Bucyrus No. 24 dragline.

The Bucyrus excavator loads in 20-yd. Western dump cars, which in turn dump into two V-shaped hoppers feeding onto a 30-in. inclined conveyor belt that discharges into a 60-in. diameter by 48-ft. long trommel. All material over three inches in diameter passes to a bin that feeds a Farrell jaw crusher. The undersize passes through three sets of conical screens operated in pairs producing the various sizes of screened gravel and sand product. This sand product flows over Hungarian riffles for the recovery of gold, the deposit as a whole carrying a few cents a ton. Quicksilver is used in the riffles. The riffle discharge passes to Dorr and Bodison classifiers which make separation of coarse concrete sand and fine plaster sand.

The crushed rock from the Farrell jaw crusher passes by belt conveyor to another trommel 48 in. in diameter with three sections, 2-in., 1½-in. and 1-in. The oversize from the 2-inch section goes to a McCully gyratory and then to a Symons 48-in. disc. The minus 2-inch from the first section is also re-crushed in a second Symons disc reducing it to minus ½-inch. Materials produced are crushed rock (gravel) 2½, 1½, 1-, ¾- and ½-in. Screened gravel ¾-, 2-, 1- and ½-in., and ½- and ¼-in. down. Bunker capacity is 20 cars. A belt conveyor operates in a tunnel below the bunkers so that any size or blend of grades may be drawn out. It goes up an incline to a car-loading hopper over railroad tracks. A Brownhoist locomotive crane is used for unloading and loading cars in the yard from stock piles. Electric power is used throughout the plant. The capacity is 60 cars (railroad) per day or 3000 tons, one shift. Fifteen men are employed. A. H. Signet, plant superintendent.

#### TALC

Samples of a good grade of talc, in part foliated, from near Kings River have been submitted to the Division Laboratory by W. F. McMurtry, Toll House.

#### TANTALUM

Columbite (Tantalite) has been found in the Kings River district.

Bibl: State Mining Bureau Bull. 91, p. 254.

#### TUNGSTEN

Wolframite, with which tin ore is associated, is reported as occurring in the high Sierran country in eastern Fresno County, and scheelite in a vein carrying gold values on a claim near Trimmer and in T. 12 S. R. 27 E. There has been no production.

Bibl: State Mineralogist's Report XIV, p. 470.



**LAKE COUNTY**

By CHAS. VOLNEY AVERILL, Mining Engineer.

**Geography.**

Lake County lies practically due north of San Francisco at a distance by road of about 100 miles. Mendocino County, which is about 40 miles wide, lies between Lake County and the Pacific Ocean. Lakeport, located on the shore of Clear Lake, is the county seat and the only town of any size. Upper Lake, Kelseyville, Lower Lake and Middletown are small towns located in various parts of the county. The 1920 census gives Lake County a total population of 5542 persons. The land area is 1278 square miles

**Topography.**

Clear Lake, a body of fresh water 25 miles long and from 3 to 10 miles wide, occupies a position near the center of the county. The county boundaries follow the ridges of the mountains; and in the central portion a basin-like region drains into Clear Lake, which in turn has an outlet into Cache Creek and the Sacramento River. The more mountainous northern portion drains through Eel River into the Pacific Ocean; and large tracts to the east and south drain through Cache Creek and Putah Creek in an easterly direction into the Sacramento River. Elevations range from 1340 feet above sea level at Clear Lake to over 7000 feet at Snow Mountain.

**Climate.**

The climate is mild, without extremes of either heat or cold; and falls of snow are common only at the higher elevations. Annual rainfall is about 35 inches. The pleasing summer climate and the attractive mountain and lake scenery are drawing many people to the numerous summer resorts. Hunters and fishermen also find the climate and mountains, lakes and streams much to their liking.

**Transportation.**

Lake County has no railroad service, and is dependent entirely on the State highways and county roads for transportation. Winding over the mountain at an easy grade, an excellent highway crosses Mt. St. Helena on the southern county line, and connects Calistoga, the railroad terminus in Napa county, with Middletown. Similar highways connect Lakeport with Hopland and Upper Lake with Ukiah. Roads connecting Lake County with points to the east, such as Williams, are steep and narrow in places, and become muddy in wet weather. The Ukiah-Tahoe State highway, now under construction, is designed to remedy this condition. The road between Ukiah and Upper Lake, mentioned above, is a part of this highway. Kelseyville, Lower Lake and other points in the county are reached by means of graveled and dirt roads. Small boats are operated between points on the shore of Clear Lake, chiefly for pleasure.

**Industries.**

Agriculture is the chief industry. Bartlett pears, walnuts, almonds, prunes, apples, grapes and olives are important; and oranges, figs,

berries, melons and other fruits are grown. Other important crops are wheat, barley, corn, oats, beans, alfalfa and hops. The live stock industry flourishes, with the higher mountains furnishing abundant summer range, and the foothill country and alfalfa fields taking care of the stock in the winter. Practically all of Lake County north of Clear Lake is in the California National Forest, which extends northerly into the southern part of Trinity County. In this entire forest are four billion feet of pine and fir timber on government land, and two billion feet on private land. Chamiso brush occurs in dense stands in this forest up to elevations of 3500 and 4000 feet. Above this are fine stands of pine and fir. Extensive areas of scrub white oak are characteristic of the region. The mature government timber is available for sale under competitive bids; but, on account of the lack of suitable transportation within the forest, no large sales have been made. The forest is the best-stocked deer region in California, and is a favorite with sportsmen. The Columbian black-tail deer abound in the brush as well as in the timber belt.

The summer resort business is a thriving one in Lake County. The mineral springs with their hotels and baths form one type of resort; the lake resorts with fishing, swimming and boating make up a second type; and the mountain camps with their attractions of hunting and fishing form a third type. Several tracts of land near Clear Lake have recently been subdivided into lots and sold as sites for summer homes.

#### Geology and Mineral Deposits.

The 'Geological Map of the State of California,' published by this Division in 1916, indicates that the rocks of Lake County are largely Franciscan (Jurassic) sedimentary formations. A few areas of volcanic rocks are shown; but a map on a larger scale and in greater detail would show that these volcanic formations are of greater extent than there indicated. Serpentine, which is an alteration product of basic rocks that probably were intruded into the Franciscan, is an important formation; but on the map, it has been included with the sediments. Maps that indicate the importance of these igneous formations in portions of the county are to be found in Bulletin 78 of this Division, pages 30 and 32.

Minerals of commercial importance are associated with the igneous formations. A little chromite and manganese have been produced, but the important production has been that of quicksilver; and present high prices have stimulated production of the liquid metal. Mineral springs continue to be of importance both as sources of water for bottling and as centers of attraction for resorts and sanitariums.

Recorded mineral production of the county is shown by the accompanying tabulation.

## MINERAL PRODUCTION OF LAKE COUNTY, 1873-1927.

Year	Quicksilver		Mineral water		Chromite		Miscellaneous stone <sup>1</sup> , value	Miscellaneous and unapportioned		
	Flasks	Value	Gallons	Value	Tons	Value		Amount	Value	Substance
880		\$70,790								
1,695		178,280								
8,821		743,287								
14,199		624,756								
18,100		675,130								
14,428		474,681								
15,582		309,303								
17,148		531,588								
17,393		518,833								
10,193		287,748								
6,481		186,329								
4,182		127,551								
4,765		146,524								
3,498		124,179								
4,307		182,509								
6,636		282,030	*	*						
4,713		212,085	*	*						
4,232		222,180	*	*						
4,975		225,119	*	*						
11,140		453,509	*	*						
9,731		357,614	*	*						
12,471		382,954	*	*						
12,856		465,074	87,500	\$42,000						
6,307		232,484	65,920	32,460						
3,585		134,546	511,950	76,585						
1,729		64,746	523,000	37,350						
2,954		128,179	166,020	75,924						
3,165		127,345	758,600	45,400						
4,395		211,324	201,706	120,360						
3,611		161,568	241,100	126,663						
2,595		106,397	381,040	187,621						
2,854		109,719	650,000	221,000						
1,462		51,937	489,000	219,500						
1,066		38,909	365,000	160,000						
802		30,604	304,340	130,936						
1,300		54,951	246,545	118,300			\$10,000			
1,075		56,277	265,000	108,270					\$28,423	Unapportioned, 1900-1909.
1,048		47,422	212,546	95,005						
899		41,363	227,440	58,933						
209		8,786	202,000	114,500						
395		15,891	209,750	109,938						
351		16,236	254,150	47,267						
492		41,660	165,130	24,371			5,000		1,503	Copper, gold, silver.
1,139		106,496	195,650	54,160	871	\$15,070	4,500		770	Other minerals.
1,067		107,071	129,157	22,685	1,466	36,326	2,500	85 tons	1,900	Manganese.
1,540		172,173	87,067	15,006	476	24,790	1,000		70	Other minerals.
									2,907	Manganese and natural gas.
229		20,604	62,839	17,471	3		1,200		100	Other minerals.
385		24,314	43,693	16,413	84	1,560	13,200	247 tons	7,816	Manganese.
22		880	54,715	26,751			146,508		250	Other minerals.
38		2,000	60,420	29,370			16,669		250	Other minerals.
17		1,050	63,730	44,738			55,000		250	Other minerals.
			66,420	59,423			22,833		14,140	Natural gas and quicksilver
			62,970	57,793			15,300		255	Copper and natural gas.
86		7,778	57,000	58,235			*		9,680	Natural gas and miscellaneous stone.
245		29,234	45,643	51,149			4,445	440 M cu. ft.	220	Natural gas.
Tals...	253,468	\$9,933,997	7,466,041	\$2,605,577	2,897	77,746	\$298,155		\$68,784	

<sup>1</sup> Bartlett since 1888 and Witter since 1889 reported to U. S. Geological Survey, but no segregated figures available for Lake County previous to 1895.

Includes crushed rock, rubble, rip-rap, sand, gravel.

Flasks of 75 pounds, beginning June 1, 1904. Previously 76½ pounds.

See under 'Unapportioned.'



## MINERAL PRODUCTION OF LAKE COUNTY, 1873-1927—Continued.

In addition to the above, Lake County has produced the following:

Borax	Sulphur	Pounds	Val
1864 to 1868 Borax Lake yielded 590 tons refined borax, worth \$414,636; 1872 from Lake Hachinhama, 140 tons, worth \$89,600; total 730 tons, worth \$504,236	1865.....	214,650	\$8.
	1866.....	675,963	21.
	1867.....	487,603	13.
	1868.....	503,481	10.
	Totals.....	1,881,697	\$53.

## ASBESTOS

*Copsey and Jones Prospect* is owned by Arthur Copsey of Middletown and Herbert Jones of Lakeport. It is located about a mile and a half south of Howard Springs at a distance of about 10 miles from Middletown by the Big Canyon Road. The Johns-Manville Company is said to have done a few hundred feet of development work on the deposit and to have taken out seven or eight tons of asbestos early in 1928. The property has been idle recently.

## BARYTES

In the Museum of this Division is a specimen of barytes, said to have come from an undeveloped deposit near Glenbrook.

Bibl: Cal. State Min. Bur. Report XIV, p. 204; Bull. 38, p. 360.

## BORAX

Borax was at one time produced from Borax Lake, eight miles west of north from Lower Lake, and two miles south of Sulphur Bank Mine. Commercial production was made from 1864 to 1868, by the California Borax Company. Little Borax Lake, four miles west of Borax Lake on the opposite side of Clear Lake, also produced some borax in 1872.

Bibl: State Mineralogist's Report III, pp. 14-26, 78, 79; IV, p. 91 VI, Pt. I, p. 94; VIII, p. 326; X, pp. 237, 243, 269; XII, p. 34 XIII, p. 46; XIV, p. 204; Bull. 24, pp. 51-52. Geol. Surv. of Cal., Geology Vol. I, p. 98. U. S. G. S. Mon. XIII, pp. 244 264-268; Min. Res. W. of Rocky Mts. 1867, pp. 179-187; 1868 pp. 264-266.

## CHROMITE

Chromite mining is not active in Lake County at the present time. The following deposits have been listed in Bulletin 76 of this Bureau published in 1918.

*Arthur Copsey et al.*, of Middletown, located three claims in the southwest quarter of Sec. 33, T. 12 N., R. 7 W., 23 miles north of Calistoga, the nearest railroad station, and eight miles east of Middletown. The chromite occurs in the decomposed serpentine along the top of a ridge, as small stringers from two inches to one foot in width. The deposits were mined by means of shallow trenches.

*Great Western Mine.* Location, Sec. 16, T. 10 N., R. 7 W. It is assessed to the *White Investment Company*, Newhall Building, San

Francisco. Chromite was found in decomposed serpentine on the steep slopes of a ridge at an elevation of 2350 feet, several hundred feet above the old quicksilver mine workings. The ore was in the form of an irregular lens three to five feet wide; and upward of 100 tons of ore averaging 45 to 50% chromic oxide was shipped to the Sawyer Tanning Company at Napa.

*Harp and Sons Ranch.* Location, Sec. 20, T. 11 N., R. 7 W., three miles northwest of Middletown on the Harbin Springs road. The Sawyer Tanning Company mined several pockets of high-grade ore containing 50 to 52% chromic oxide.

*Lucky Strike Mine.* Location, Sec. 24, T. 12 N., R. 6 W. The Sawyer Tanning Company leased this deposit in 1917, and over 1000 tons of ore were mined by open cut from a deposit eight feet in width. Several smaller kidneys were developed also.

#### CLAY

W. F. Dietrich in 'The Clay Resources and the Ceramic Industry of California,' Bulletin 99 of this Division, states that he made a trip to Lake County, in 1925, to examine several deposits of clay that had been reported at various times to the State Mining Bureau. "Inquiry was made among local inhabitants, and a number of localities were visited, but no evidence of these deposits could be discovered. As time was not available for prospecting, the search was abandoned. It is obvious that only a deposit of exceptionally high-grade clay would have commercial value in this region, on account of the cost of transportation to market, and while the possibility that such a deposit may be found can not be entirely eliminated, it is unlikely." The results of a test made on common clay found in an undeveloped deposit near Kelseyville are given by Dietrich. The material was found suitable for only a low grade of common brick.

#### COAL

Report XIV of this Division states that the Lake County Coal and Developing Company was incorporated to mine so-called coal from a location three miles west of Lakeport. A representative of the Division found that the material was carbonaceous shale occurring as laminations in a hard blue sandstone.

Bibl: Cal. State Min. Bur. Report XIV, p. 205.

#### COPPER

Several copper prospects and occurrences of float are mentioned in Report XIV of this Division, pages 205-206. The only activity at present is some prospecting in the vicinity of Harbin Springs.

*Copper Prince Mine* is in Sec. 19, T. 11 N., R. 7 W., 4 miles northwest of Middletown at an elevation of 2000 feet. Azurite, malachite and some sulphide have been found; and several hundred feet of development were done on this showing several years ago.

*Ed. Reynolds* of Middletown has a claim 500 feet west of the Copper Prince in Sec. 24, T. 11 N., R. 8 W., and is building a road with the

intention of shipping some of the ore, which is similar to that of the Copper Prince, mentioned above. M. A. Hunt has a claim adjoining.

#### GEM MATERIALS

*Clear Lake Gem Mining Company*, Woodland, California, is a California corporation, organized in May, 1929, with a capital stock of \$200,000. The company has a 20-year lease on the E $\frac{1}{2}$  of the NE $\frac{1}{4}$ , E $\frac{1}{2}$  NE $\frac{1}{4}$  section 10, W $\frac{1}{2}$  section 21, and all of section 20, T. 12 N., R. 7 W., M. D. B. & M., between the town of Lower Lake and Howard Springs in Lake County, California. On this property are deposits of clear white hyalite and amethystine quartz. These are being mined and cut into gems. J. F. Garrette is manager.

#### GOLD AND SILVER

A vein said to contain values in gold and silver in Sec. 31, T. 16 N., R. 9 W., is mentioned in Report XIV of this Division, page 206. The country rock is slate. Development work consisted of a 22-ft shaft with 50 ft. of drift, and a tunnel of 50 feet. The ore carries pyrite, and assays in gold and silver are reported.

*T-B-M Prospect.* In 1924 J. W. Mauldin of Findley, C. A. Traylor and G. W. Bruce obtained from the State Surveyor General a mineral lease on 160 acres of state land located in Sec. 16, T. 12 N., R. 9 W. The property is about 7 miles south of Kelseyville. There is a road to the Fifield ranch, then a trail of 1 $\frac{1}{2}$  miles to the prospect, which is situated in a rugged portion of the ridge separating Lake and Sonoma counties. The formations in this vicinity are the typical Franciscan of the coast range, consisting of carbonaceous slates, schist and serpentine, much broken and altered. Some quartz float is found in the vicinity, but no definite vein that would indicate a permanent orebody. An incline shaft 40 feet deep, with a slope of about 45 degrees, was put down along a series of small quartz lenses and silicious segregations impregnated in places with fine pyrite. Chalcopyrite and bornite also showed occasionally in small quantity. Assays were said to show values of \$3 to \$23 per ton in gold, none of which is free. So far as developed the showing is not impressive.

A somewhat similar deposit was located in 1911, in Sec. 31, T. 16 N., R. 9 W., on which some development work was done and pyrite ore, assaying from \$5 to \$34 per ton, was reported to have been found.

Bibl: State Mineralogist's Report XX, p. 85.

#### LIMESTONE

Occurrences of limestone have been noted near the Abbot quicksilver mine, and at Burns Valley north of Lower Lake. At the latter, the Sulphur Bank Mine Company at one time had two kilns.

Bibl: State Mineralogist's Reports XII, p. 392; XIV, p. 206.

#### MANGANESE

'Manganese and Chromium in California' is the title of Bulletin 76 of this Division published in 1918. At that time manganese and



chromite deposits were being actively developed because of war conditions. Very little has been done with manganese deposits in Lake County since that time; and, with the exception of a trip to the vicinity of the Phillips Manganese Mine, the properties were not visited by the writer. The following properties are described in greater detail in the references given:

*Coleman Prospect* is in Sec. 29, T. 12 N., R. 9 W. Small amounts of good ore were found in red chert; but Bulletin 76 states that no body of workable size had been discovered.

*Herman Prospect* is located in Snell Valley, 11 miles from Middletown. Specimens received from the property indicated siliceous manganese oxide.

*Herrick Prospect* is in Sec. 25, T. 11 N., R. 8 W., three miles west of Middletown. A bed of siliceous manganese oxide three feet thick was exposed in red chert.

Bibl. (three above deposits): Cal. State Min. Bureau Bull. 76, p. 37.

*Old Dough Claim* is in T. 12 N., R. 9 W.

Bibl: State Mineralogist's Report XVII, p. 78.

*Phillips Manganese Mine* is located near the top of a high ridge on the Phillips ranch, about one and a half miles south of Laurel Dell. A high-grade lens of manganese was developed; and the mine was one of the first producers in Lake County. Production has amounted to 400 or 500 tons. The owners are Clarence, Melvin and Mrs. Catherine Phillips of Bachelor post office. H. C. Strader, 1201 Pawson Ave., Long Beach, has recently taken an option on the deposit. The tunnel used in former operations has caved.

Bibl: State Mineralogist's Report XVII, p. 78.

*Smythe Manganese Prospect* is three miles west of Middletown in T. 10 N., R. 7 W. on the Ormsby ranch on a branch of Dry Creek. An outcrop was found on the steep side of a hill at an elevation of 1800 feet. A lens of ore of good grade was developed for a length of 30 to 40 feet and a width of  $2\frac{1}{2}$  to 3 feet. The country rock is sandstone and jasper.

Bibl: State Mineralogist's Report XVII, p. 79.

*Van Ranch Deposit* is in Secs. 3 and 10, T. 16 N., R. 10 W. It was described as a deposit of some promise in Bulletin 76; but Report XVII states that it has been worked out.

Bibl: State Mineralogist's Report XVII, p. 78. Cal. State Min. Bur. Bull. 76, p. 37.

#### MINERAL PAINT

Two deposits of mineral paint (ochre) that have been utilized locally have been reported. One is in Sec. 3, T. 15 N., R. 7 W., two miles north of Hough Springs. The other is in Sec. 8, T. 11 N., R. 5 W., in Jerusalem Valley near Dollar Springs, northeast of Middletown.

Bibl: State Mineralogist's Report XIV, p. 207.

## MINERAL SPRINGS

Lake County probably has a greater number and variety of mineral springs than any other equal area in the United States. Bradley<sup>1</sup> has described the springs in considerable detail; and no attempt has been made to repeat the complete survey made by him. Some new notes have been gathered on recent developments at the springs, in the course of the present survey, which has been devoted largely to the mines. Locations have been checked and names of present owners have been obtained from the records of the county assessor.

*Adams Springs* are in Sec. 26, T. 12 N., R. 8 W., seven miles southwest of Lower Lake, and thirty miles north of Calistoga. The beautiful wooded country of the western part of Lake County makes a fine setting for this resort, which is in the canyon at the head of Putah Creek at an elevation of about 3000 feet. The timber is pine, fir and oak. Charles Adams first took up the springs in 1872; and the present owner, Dr. W. R. Prather of Adams Springs post office, has owned them since 1888. A new hotel, said to have cost \$100,000, was built in 1927; and there are cottages, tents, swimming tank, baths and dance pavilion. The resort is equipped with its own hydro-electric plant, with which numerous electric lights around the buildings and grounds are operated. The main spring gives alkaline water containing carbon dioxide.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 61; VIII, p. 327; XII, p. 334; XIII, p. 511; XIV, p. 211. R. of M. Lake Co., p. 5. U. S. G. S. Bull. 32, pp. 203, 210; Water Sup. Pap. 338, p. 189. Anderson,<sup>†</sup> p. 68.

*Allen Springs* are in Sec. 8, T. 15 N., R. 7 W., in the canyon of Bartlett Creek, three miles below Bartlett Springs, on the Williams-Bartlett road. There are numerous strong springs in the bed and side of the creek: 'White Sulphur,' 'Soda,' 'Soda and Iron' (3 springs), etc. They are owned by the North Butte Country Club, Live Oak, California. No improvements have been added.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 62; VIII, p. 327; XII, p. 334; XIII, p. 511; XIV, p. 212. R. of M. Lake Co., p. 5. U. S. G. S. Bull. 32, p. 203; Water Sup. 338, p. 198. Anderson (op. cit.), pp. 76-78.

*Anderson Springs* are in Sec. 25, T. 11 N., R. 8 W., six miles northwest of Middletown and 24 miles north of Calistoga, in the timbered section of southwestern Lake County. Eight springs have been utilized, but there are several others. Both cold and warm springs occur, the names of some of them being: 'Iron,' 'Sour,' 'Magnesia,' 'Hot Sulphur and Iron,' 'Iron and Magnesia' and 'Steam Bath.' The last two named give off hydrogen sulphide. Epsom and Glauber's salts are found in some of the springs, also traces of chromium. A family resort has been operated at these springs for many years; but no improvements have been added recently. E. W.

<sup>1</sup> Walter W. Bradley, Cal. State Min. Bur. Report XIV, p. 207, 1914.

<sup>†</sup> Dr. Winslow Anderson, Mineral Springs and Health Resorts of California, 1890.

Schwartz of Lakeport has recently acquired a large interest in the property, the balance of which is held by the Anderson sisters.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 62; VIII, p. 327; XII, p. 335; XIII, p. 511; XIV, p. 212; XVII, p. 79. R. of M., Lake Co., p. 5. U. S. G. S. Bull. 32, p. 203; Water Sup. Pap. 338, pp. 89-91. Anderson (op. cit.), pp. 82-89.

*Bartlett Springs* are in Sec. 2, T. 15 N., R. 8 W., 42 miles from Williams on the east. The road continues on past the springs, which are at an elevation of 2350 feet, crosses a summit at 4040 feet elevation and continues to Upper Lake and Lakeport. The view of Clear Lake and surrounding country from the summit is very fine. The Bartlett Springs Company, H. E. Reed, secretary, 71 Bluxome St., San Francisco, is present owner. Although it is farthest from the railroad of any of the resorts in Lake County, Bartlett Springs is one of the best equipped. A modern hotel to accommodate 500 people, dance pavilion, tennis court, swimming tank and baths are included. The surrounding country affords good hunting. Water from the springs, which contains an excess of natural carbon dioxide, is bottled and marketed as a drinking water.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 92; VIII, p. 327; X, p. 253; XII, p. 335; XIII, p. 511, XIV, p. 215, XVII, p. 79. R. of M. Lake Co., p. 5. U. S. G. S. Bull. 32, p. 203; Water Sup. Pap. 338, p. 201. Anderson (op. cit.), pp. 91-94.

*Behr Soda Spring* is in Sec. 10, T. 13 N., R. 8 W., on the edge of Clear Lake, five miles east of Kelseyville, and stands in the name of the Lake County Abstract and Title Company of Lakeport. It is reported that a new company is to take over this spring and install improvements.

Bibl: R. of M. Lake Co., p. 5.

*Blue Lakes* are in Sec. 6, T. 15 N., R. 10 W., 18 miles east of Ukiah. Two springs, a 'sulphur' and an 'iron' occur on the property, which is owned by the Blue Lakes Realty Company. H. W. Kemp of Midlake is manager of the resort.

Bibl: R. of M. Lake Co., p. 5.

*Bonanza Springs* are in Sec. 30, T. 12 N., R. 7 W., between Seigler and Howard Springs, five miles southwest of Lower Lake, and two miles east of Adams Springs. A large hotel that was operated at these springs at one time was destroyed by fire; and no improvements have been added recently. Cool springs of several different kinds occur here. The present owner is Dr. Herbert Scholtz, 3503 Grove Street, Oakland.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 92; VIII, p. 327; XII, p. 335; XIII, p. 511; XIV, p. 215; XVII, p. 79. R. of M. Lake Co., p. 5. U. S. G. S. Bull. 32, p. 204; Water Sup. Pap. 338, p. 190. Anderson (op. cit.), p. 100.



*Borax Springs.* There are borax springs on the edge of Clear Lake near Borax Lake, owned by Clear Lake Company, and near Little Borax Lake, owned by Geo. H. Hotaling of San Francisco.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 63; VIII, p. 327; X, p. 239; XIV, p. 215. R. of M. Lake Co., p. 5. Geol. Surv. of Cal., Geol. Vol. I, p. 99; U. S. G. S. Mon. XIII, pp. 266-268. Anderson (op. cit.), pp. 101, 168, 176.

*Bynum Spring* is in Sec. 9, T. 13 N., R. 10 W., six miles southwest of Lakeport, at the head of a small branch of Scott Creek that is dry in summer. The surrounding hills are bare except for chamiso brush. Water containing a slight excess of gas was formerly bottled and shipped, but there has been no activity at this spring recently. The Estate of Josephine Boggs, c/o F. H. Boggs, Lakeport, is the owner.

Bibl: State Mineralogist's Report XVII, p. 79, R. of M., Lake Co. p. 5. U. S. G. S. Water Sup. Pap. 338, p. 182.

*Carlsbad Springs* are in Sec. 1, T. 12 N., R. 9 W., five miles south of Kelseyville, and are owned by Geo. P. McGovern, 3772 25th Street San Francisco.

Bibl: R. of M. Lake Co., p. 5; U. S. G. S. Water Sup. Pap. 338, p. 187.

*Castle Springs* (Mills, Noble's) are in Sec. 26, T. 11 N., R. 8 W. seven miles northwest of Middletown. A resort was formerly operated here and a concrete swimming pool 25 by 60 feet was installed. It is owned at present by the Homes and Childrens Alliance, associated with the Salvation Army, 351 63d Street, Oakland. The 'Big Hot Sulphur Spring' flows about 40,000 gallons per 24 hours of water of a temperature of 163° F. at the Spring. Several smaller springs occur on the property.

Bibl: State Mineralogist's Report VIII, p. 328; XII, p. 337; XIII, p. 511; XIV, p. 216; XVII, p. 79. U. S. G. S. Bull. 32, p. 206; Water Sup. Pap. 338, pp. 91-93. Anderson (op. cit.), p. 194.

*Chambers Ranch* in Sec. 24, T. 13 N., R. 10 W., six miles south of Lakeport, contains several springs.

Bibl: State Mineralogist's Report XIV, p. 216.

*Complexion Springs* are in Sec. 10, T. 15 N., R. 6 W., on the Williams-Bartlett road, near the eastern boundary of the county, and are utilized only by campers. The water has a milky appearance and contains sodium chloride and ammonia. Winfield Haring, R. F. D. Box 557, Modesto, is the owner.

Bibl: State Mineralogist's Report XIV, p. 217. R. of M., Lake Co., p. 5. U. S. G. S. Water Sup. Pap. 338, p. 297.

*Copsey Springs* (see *Spires*).

*Crabtree Springs* are in Sec. 25, T. 17 N., R. 9 W., about 12 miles northwest of Bartlett Springs. Estate of S. T. Packwood is the owner.

Bibl: State Mineralogist's Report XI, p. 61; XIV, p. 217. R. of M. Lake Co., p. 5. U. S. G. S. Water Sup. Pap. 338, p. 106.

*Dennison* (see *Hazel*).

*Dinsmore Springs* (soda and iron) in Sec. 11, T. 14 N., R. 7 W., are owned by C. R. Dow of Lower Lake.

*Dollar Springs* are in Sec. 8, T. 11 N., R. 5 W., on Black Mountain, 11 miles northeast of Middletown, and are owned by B. Norman of Middletown. They were formerly known as Warm Springs.

Bibl: State Mineralogist's Report XIV, p. 217.

*Grizzly Medical Springs* (Richardson's) are in Sec. 3, T. 13 N., R. 6 W., five miles west of Sulphur Creek in Colusa County. Water has been bottled in a small way, and a few cottages and space for campers were available. No improvements have been made recently.

Bibl: State Mineralogist's Reports IV, p. 230; VI, Pt. I, p. 63; X, p. 264; XIV, p. 217. U. S. G. S. Bull. 32, p. 205; Water Sup. Pap. 338, p. 193. Anderson (op. cit.), p. 183.

*Harbin Hot Springs* are in Sec. 20, T. 11 N., R. 7 W., three and a half miles northwest of Middletown and 20 miles north of Calistoga, and the owner is N. S. Booth of Middletown. A resort with hotel and cottages with all modern conveniences is operated throughout the year. New buildings have been added so that about 400 persons can now be accommodated. A swimming tank and dancing pavilion are included. The following are included in the springs that occur here: 'hot sulphur,' 'iron,' 'magnesia,' 'cold white sulphur,' and a large fresh water spring.

Bibl: State Mineralogist's Reports VIII, p. 327; X, p. 230; XII, p. 336; XIII, p. 511; XIV, p. 218; XVII, p. 79. R. of M. Lake Co., p. 6. U. S. G. S. Bull. 32, p. 205; Water Sup. Pap. 338, pp. 93-95. Anderson (op. cit.), pp. 164-168.

*Hachinhama* (see *Borax Springs*).

*Hazel Springs* (Dennison) are in Sec. 26, T. 16 N., R. 9 W., six miles northeast of Upper Lake, and are owned by Ruth J. Misch, c/o Amos Ogden, Upper Lake. They are utilized by campers only.

Bibl: State Mineralogist's Report XIV, p. 218. U. S. G. S. Water Sup. Pap. 338, p. 202.

*Highland Springs* are in Sec. 31, T. 13 N., R. 9 W., 14 miles east of Pieta, a railroad station in Mendocino County. Abe Ruef of San Francisco is the owner; and a resort is operated. Of the many springs on this property, the following are the more important: 'Neptune,' 'Iron,' 'Diani,' 'Seltzer,' 'Kidney,' 'Magic,' two 'Magnesia,' 'Sulphur,' 'Ems,' and 'Arsenic.' Temperatures range from 60° to 80° F., and carbonic acid gas is given off, the 'Magic' being especially vigorous.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 62; VIII, p. 328; XII, p. 336; XIII, p. 511; XIV, p. 219; XVII, p. 79. R. of M., Lake Co., p. 6. U. S. G. S. Bull. 32, pp. 205-212; Water Sup. Pap. 338, pp. 183-185. Anderson (op. cit.), pp. 169, 175.

*Hoppin Estate*. There are two springs on this property, which adjoins the Bartlett Springs property. They are about 100 feet apart,

and about 100 yards from Bartlett's 'soda-magnesia.' These are the two springs included in Register of Mines of Lake County, p. 5, under Bartlett, as 'Iron No. 4' and 'Magnesia No. 5.'

Bibl: U. S. G. S. Water Sup. Pap. 338, p. 201.

*Hough Springs* are in Sec. 10, T. 15 N., R. 7 W., eight miles east of Bartlett Springs on the road to Williams, and on the north fork of Cache Creek. There are several springs of different kinds, the soda spring giving a water heavily charged with carbonic acid gas. The resort consists of a hotel, cottages and tents. Geo. F. Abel of Williams is the owner.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 63; XIV, p. 220; R. of M. Lake Co., p. 6. U. S. G. S. Bull. 32, p. 206; Water Sup. Pap. 338, p. 197. Anderson (op. cit.), p. 180.

*Howard Springs* are in Sec. 30, T. 12 N., R. 7 W., seven miles southwest of Lower Lake or 14 miles northwest of Middletown, and are owned by Mary Clancy, c/o G. J. Hatfield, Chancery Building, San Francisco. The resort, consisting of hotel and cabins, is operated by J. P. Francisco of Middletown. About forty different flows of several different kinds are found here, temperatures varying from 65° to 110° F.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 63; VIII, p. 328; XII, p. 337; XIII, p. 511; XIV, p. 221. R. of M. Lake Co., p. 6. U. S. G. S. Bull. 32, p. 206; Water Sup. Pap. 338, p. 95. Anderson (op. cit.), pp. 180, 181.

*McIntyre Ranch*, six miles from Kelseyville, contains an 'Iron Spring,' owned by Murdock McIntyre.

*Mills Springs* (see *Castle Springs*).

*Newman Spring* is in Sec. 35, T. 16 N., R. 8 W., one and a half miles north of Bartlett Springs, and is owned by Geo. Young of Bartlett Springs. The water contains borax.

Bibl: State Mineralogist's Reports X, p. 254; XVII, p. 80. R. of M. Lake Co., p. 6. U. S. G. S. Water Sup. Pap. 338, p. 202.

*Paramore Spring* is in Sec. 21, T. 17 N., R. 9 W., near Upper Lake, and is owned by E. R. Smith. The water contains soda and iron.

*Pierson Springs* (see *Saratoga Springs*).

*Quigley Soda Springs* are on the Quigley ranch at Arabella.

*Red Wing Spring* (see *Spiers Springs*).

*Richardson* (see *Grizzly*).

*Roaring Soda Spring* (Morton) is in Sec. 15, T. 18 N., R. 10 W., near Hullville, and is owned by J. M. Macdonough. Campers occasionally use the spring.

*Royal Spring* is in Sec. 7, T. 16 N., R. 8 W., and is owned by Dr. E. S. Holway of Colusa.

*Saratoga Springs* (Pierson) are in Sec. 4, T. 15 N., R. 10 W., 22 miles north of east of Ukiah and six miles west of Upper Lake, and are



owned by E. R. Keil of Bachelor P. O., which is the name of the post office at the springs. The resort consists of a good hotel and bathhouse, cottages for housekeeping, and swimming tank. Dancing and other amusements are provided. The principal springs in use are two 'magnesia,' 'arsenic,' 'sulphur,' 'soda,' 'iron' and 'seltzer.'

Bibl: State Mineralogist's Reports VI, Pt. I, p. 63; VIII, p. 328; XII, p. 337; XIII, p. 511; XIV, p. 222; XVII, p. 80. R. of M. Lake Co., p. 7. U. S. G. S. Bull. 32, p. 207; Water Sup. Pap. 338, p. 179. Anderson (op. cit.), pp. 220, 242.

*Seigler Springs* are in Sec. 24, T. 12 N., R. 8 W., five miles southwest of Lower Lake and 30 miles north of Calistoga, at an elevation of about 2500 feet. The owner is the Seigler Springs Company, for which Mrs. M. E. Roberts of Seigler post office is manager. A family resort is operated at these springs in the pine forest. The hotel and cottages for housekeeping have accommodations for about 250 persons. A dance hall and swimming pool are provided; and fishing and hunting are said to be good. The large variety of mineral springs ranges in temperature from 64° to 126° F.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 63; VIII, 328; X, p. 230; XII, p. 337; XIII, p. 511; XIV, p. 223. R. of M. Lake Co., p. 7. U. S. G. S. Bull. 32, p. 207; Water Sup. Pap. 338, pp. 96-98. Anderson (op. cit.), p. 243.

*Soap Creek* (see *Newman*).

*Soda Bay Springs* are in Sec. 6, T. 13 N., R. 8 W., on the west shore of Clear Lake, four miles northeast of Kelseyville, and at the base of Mount Konocti. Furnished bungalows and tents for housekeeping are provided; and amusements consist of dancing, swimming, boating, hunting and fishing. 'Soda' springs occur here, both on the shore and out in the lake. The carbonic acid gas escaping from a submerged spring in the lake raises the surface of the water about a foot. The property stands in the name of the Lake County Abstract and Title Company of Lakeport. Additional improvements are said to be planned.

Bibl: State Mineralogist Reports VIII, p. 328; X, p. 242; XIV, p. 223; R. of M. Lake Co., p. 7. U. S. G. S. Water Sup. Pap. 338, pp. 191-192. Anderson (op. cit.), p. 245.

*Spiers or Red Wing Spring* (Copsey) is in Sec. 5, T. 11 N., R. 7 W., eight miles west of north from Middletown. The litigation, mentioned in Report XIV of this Division, between Joshua Spiers of Middletown and M. Hoberg of Cobb post office is still pending, both claiming the property.

Bibl: State Mineralogist's Report XIV, p. 223. R. of M. Lake County, pp. 5, 7. U. S. G. S. Water Sup. Pap. 338, p. 190.

*Spring Hill Farm Resort* is in Sec. 8, T. 10 N., R. 8 W., near Middletown, and is owned by L. S. Peterson. A small 'iron and magnesia' spring occurs here.

*Sulphur Bank* (see under *Quicksilver*).

*Witter Springs* are in Sec. 5, T. 15 N., R. 10 W., seven miles west of Upper Lake and 21 miles east of Ukiah. The main spring gives a medicinal water of high mineral content, 1019 grains per gallon; and the output is shipped and bottled for sale. A resort is no longer operated; and the buildings formerly used for that purpose have been wrecked. The owner is Witter Springs, Inc., 62d and La Salle Street, Chicago.

#### NATURAL GAS

At Kelseyville, a flow of gas was struck in a well at a depth of 158 feet; and at one time, the gas was utilized in lighting.

Bibl: State Mineralogist's Reports VII, p. 184; VIII, p. 326; X, pp. 241, 271; XI, p. 63; XIV, p. 225. U. S. G. S. Water Sup. Pap. 338, p. 181. Anderson (op. cit.), pp. 182, 266-269.

At Thurston Lake, a small body of water without an outlet located about four miles west of Lower Lake near the southern end of Clear Lake, natural gas can be seen bubbling through the water when the surface is quiet. Pipes have been driven into the mud of the lake-bottom; and the gas has been collected and used for lighting, kitchen ranges and driving gas engines.

Bibl: State Mineralogist's Report XVII, p. 80.

*R. D. Frey* of Lower Lake uses natural gas from Thurston Lake for lighting and cooking.

*Louis Jago* of Lower Lake uses natural gas for domestic purposes. The gas is methane.

*Geo. Miller* of Lower Lake uses natural gas for lighting, cooking and operating a small refrigerating plant.

#### PETROLEUM

The Franciscan (Jurassic) rocks and the intrusive and extrusive igneous rocks that cover practically the whole of Lake County are considered unfavorable to the occurrence of petroleum.

Bibl: Cal. State Min. Bur. Bull. 89, pp. 49-51.

#### QUICKSILVER

Quicksilver mining is very active in California and Nevada at the present time because of the high market price of the liquid metal. The price is being maintained by an agreement between Spanish and Italian producers, made through their governments, to market through a central agency. These producers have the advantage over operators in this country, that European ores are much higher in grade. Spain and Italy furnish 90% of the world's supply; while this country produces less than half of its own requirements. New uses of quicksilver that will tend to keep the price high have been mentioned in the report on Napa County (see page 226, *ante*).

The rotary furnace, patterned after the cement kiln, with an oil burner inside, is being used exclusively in metallurgical plants recently

installed to treat quicksilver ore. H. W. Gould, who has installed several of these furnaces recently, estimates that with a three-foot furnace, treating 40 tons per 24 hours, cost of extraction is \$1.35 per ton of ore. The corresponding figure for a four-foot furnace, treating 100 tons per 24 hours is from \$0.78 to \$1.15, depending on the cost of transporting oil and supplies. These figures are said to include all operating costs (treatment only) and depreciation.

*Abbott Mine* is in Sec. 32, T. 14 N., R. 5 W., about two miles east of Wilbur Springs, and is assessed to Theodore Smith, 521 Fifteenth Street, Sacramento. Production was made from 1870 to 1879, and from 1889 to 1906; but no important production has been made since. The ore occurs on a contact of serpentine with shale and sandstone. Idle.

Bibl: State Mineralogist's Reports IV, p. 336 (table); XI, p. 239; XII, p. 360; XIII, p. 595; XIV, p. 229; XVII, p. 81; Chap. Rep. Bien. period 1913-1914, p. 57; Bull. 27, pp. 46-48, 227; Bull. 78, pp. 53-55; Reg. of Mines, Lake Co., p. 3. U. S. G. S. Mon. XIII, p. 368; Min. Res. 1902. Geol. Surv. of Cal., Geology, Vol. II, p. 124. Min. Res. W. of Rocky Mts. 1876, p. 19.

*American* (see *Helen*).

*Anderson Prospects* (see *Big Chief* also) are in Sec. 25, T. 11 N., R. 8 W., at Anderson Springs, and are owned by the Anderson sisters and E. W. Schwartz of Lakeport. Schwartz has found a cinnabar prospect in the bed of the creek, about half a mile below the resort at the springs, and is sinking on it. Equipment includes a compressor driven with a Fordson tractor, a jackhammer drill and a small pump driven by a gasoline engine. The shaft was down about 10 feet, but was full of water at the time of visit. A five-pipe retort has recently been added.

Bibl: State Mineralogist's Reports XIV, p. 230; XVII, p. 81; Bull. 27, p. 48; Bull. 78, p. 55; Chapter rep. bien. period, 1913-1914, p. 58.

*Bacon* is not active.

Bibl: State Mineralogist's Reports IV, p. 336 (table); XIV, p. 230; Reg. of Mines Lake Co., p. 3; Chapter rep. bien. period 1913-1914, p. 58.

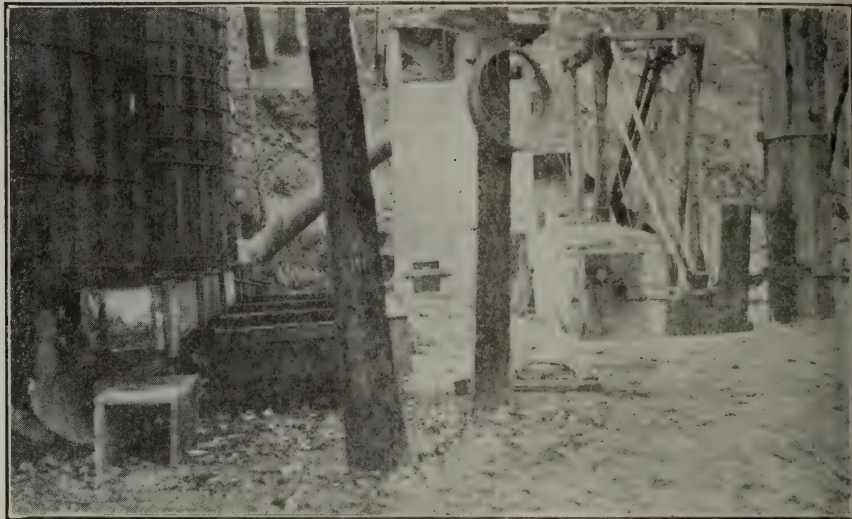
*Baker Mine* is in Sec. 16, T. 12 N., R. 6 W., six miles southeast of Lower Lake, and is owned by L. H. Fuqua of Lower Lake. 108 acres of patented land are held. The mine was worked at least as early as 1870, and at various times since in a small way. In 1917 a two-compartment shaft was sunk; and some drifting was done. All of the old workings are now caved and abandoned. Some cinnabar can be seen near the surface associated with serpentine and decomposed material heavily stained with oxides of iron. The owner states that the early production amounted to about 150 flasks, and that during the late war to 45 or 50 flasks. Further prospecting of the property was being considered at the time of visit.

Bibl: State Mineralogist's Reports XI, p. 67; XII, p. 360; XIII, p. 595; XIV, p. 230; XVII, p. 81; Chap. rep. bien. period 1913-



1914, p. 58; Reg. of Mines of Lake Co., p. 3; Bull. 27, p. 49; Bull. 78, p. 55; U. S. G. S. Mon. XIII, p. 368; Geol. Survey of Cal., Geology, Vol. II, p. 125.

*Baxter Prospect* (G. L. Hildebrand) is in Sec. 32, T. 13 N., R. 8 W., about six miles southeast of Kelseyville, and is owned by W. C. Baxter,



Big Chief Mine. Front and side views of new furnace and condensers.

c/o L. Keithly, Lower Lake. Work done at the time of visit indicated a deposit of quicksilver ore 30 ft. wide and 400 ft. long and about 30 feet deep, with a few feet of overburden. However, further development work will be required to prove that the deposit is continuous.

One end is developed by means of a cut 40 ft. long with a 20 ft. face, the other end by three shafts, one 30 ft. deep, the other two 17 feet deep. A tunnel, thought to be 200 feet long, has been driven into the hillside below the cuts by earlier prospectors, but is bulkheaded at the 100 ft. point. Plans were being made to clean this out and advance it to a point under the deposit. Cinnabar has been deposited in fractures in rhyolite and obsidian. The type of alteration of the rocks is a little like that at the Sulphur Bank mine. A basalt dike occurs just to the west of the deposit; and there are indications of one to the east also. Baxter states that his samples indicate an average grade of one-half of one per cent quicksilver in the ore, and that two or three flasks were produced here in 1917 or 1918.

Bibl: State Mineralogist's Report XVII, p. 82.

*Big Chief Mine* is in Secs. 25 and 35, T. 11 N., R. 8 W., on the Anderson Springs property, and is owned by Rose Anderson and sister



'D' retorts at Big Chief Mine.

of Anderson Springs (via Middletown). A lease and option are held by the Big Chief Mining Corporation, Clarence Lindville, president, Middletown, Wm. Nystrom, secretary, 2850 Webster St., Berkeley; and this corporation is operating the property. A tunnel, 350 ft. long, had cut 20 ft. of ore in chert and immediately beyond another 20 ft. of ore in sandstone. A second tunnel driven from a point around the hill from the first, in a direction at about a right angle and 22 ft. lower, was 450 ft. long. This tunnel penetrated 12 ft. of sandstone ore and 12 ft. of chert ore. The horizontal distance from the face of the first tunnel to the side of the second is 110 feet; and the operators think that a continuous body of ore will be developed between the two. In addition to the tunnels, several surface cuts have been made; and ore was being taken from one of these at the time of visit. The photographs show a new plant, consisting of small rotary furnace and condensing



system, that has recently been installed for the company by John Andrews. 15 tons per day is the rated capacity; and the cost was about \$15,000. The furnace is equipped with an oil-burner. Production from the new plant had been 12 flasks at the time of visit. The condensing system consists of one condenser made of sewer tile, followed by three made of redwood; and a spray of water is fed into the top of these. The operators report the total production of the property to date at approximately 500 flasks.

Bibl: State Mineralogist's Report XVII, p. 81.

*Big Injun Mine* is in Sec. 35, T. 11 N., R. 8 W., seven miles northwest of Middletown and a mile south of Castle Springs by sled road. An automobile road goes as far as Castle Springs. This property has been worked very little since 1918, and was not visited by the writer. Bradley<sup>1</sup> describes the workings as follows:

"The mine is apparently on a contact of serpentine and sandstone, but the formations are considerably broken up at this point. There are two 'veins' or ore zones, the principal development having been done on the eastern one. The strike is NW., and the dip is SW. The width varies up to 30 feet, with ore shoots showing 1 to 4 ft. wide. \* \* \* The ore is characterized by the presence of considerable native mercury with cinnabar; and the gangue minerals are quartz and dolomite. There are three main crosscut adits the lowest being in 550 ft., reaching a depth of 150 ft. below the outcrop. At 350 ft. in on this crosscut there is a hot sulphur spring."

Report XVII states that the equipment formerly on the Big Injun, described by Bradley, was removed to the Big Chief. The Big Injun is owned by Ellis Armstrong of Calistoga.

Bibl: State Mineralogist's Reports XIV, p. 230; XVII, p. 81; Bull. 27, p. 50; Bull. 78, p. 57. Chapter rep. bien. period, 1913-1914, p. 58.

*Bullion Mine* is in Sec. 22, T. 10 N., R. 7 W., four miles south of Middletown, between the Mirabel and Great Western, and is owned by B. H. Otto of Middletown. It was formerly operated by the Mirabel Company; and, in the spring of 1917, a few flasks of quicksilver were produced by concentrating old dump material. Equipment has been destroyed by fire. No recent activity has been reported on this property.

Bibl: State Mineralogist's Reports XII, p. 360; XIII, p. 595; XIV, p. 230; XVII, p. 81; Chap. rep. bien. period 1913-1914, p. 58; Bull. 27, pp. 60, 61; Bull. 78, p. 57.

*Chicago Mine.* (Pittsburg, Ural) is in Sec. 1, T. 10 N., R. 8 W., about one half mile west of the Wall Street mine near Middletown. The last known owner is the *Chicago Quicksilver Mining Company*, 522 Bank of San Jose Building. San Jose, California, but the property is not now carried on the books of the county assessor. An experiment was started here with a furnace made of concrete, but it was not finished. The concrete probably would have disintegrated, if operation had been attempted. No recent activity has been reported.

Bibl: State Mineralogist's Reports XIII, p. 595; XIV, p. 230; XVII, p. 81; Chap. rep. bien. period, 1913-1914, p. 58; Bull.

<sup>1</sup> Bradley, Walter W., Quicksilver Resources of California, California State Mining Bureau, Bull. 78, 1918.



27, p. 51; Bull. 78, p. 58; Reg. of Mines, Lake Co., p. 3. U. S. G. S. Min. Res. of U. S., 1909, Pt. I, p. 552; 1910, Pt. I, p. 697; 1911, Pt. I, p. 901; 1912, Pt. I, p. 940.

*Hildebrand* (see *Baxter*).

*Hutchinson Ranch*, southeast of Lower Lake, has been reported to contain good showings of cinnabar.

Bibl: State Mineralogist's Report XVII, p. 82.

*Fuqua* (see *Baker*).

*Great Western Mine* is in Secs. 16 and 17, T. 10 N., R. 7 W., four miles southwest of Middletown, and two miles northwest of the Mirabel, at an elevation of 1860 feet. The owner is the *White Investment Company*, Newhall Building, San Francisco. A. R. Asbill of Middletown is foreman of the ranch operated on the property. The mine was opened in 1873, and was operated until 1909, being credited with a production of 98,316 flasks. The cinnabar was found in chert associated with serpentine. Workings are extensive and reach a depth of 750 feet. The mine was abandoned several years ago, as worked out. No one was to be found in the vicinity of the old workings at the time of visit; but a few short tunnels and cuts indicated that some prospecting had been done recently. All equipment has been removed from the old workings; and they have caved.

Bibl: State Mineralogist's Reports X, p. 270; XI, p. 64; XII, p. 361; XIII, p. 595; XIV, p. 231; XVII, p. 81. Chapter rep. bien. period, 1913-1914, p. 59; Bull. 27, pp. 52-55; Bull. 78, p. 58; Reg. of Mines, Lake Co., p. 3. U. S. G. S. Mon. XIII, pp. 358-362, 470; Min. Res. of U. S., 1883, 1884, 1892, 1902, 1906, 1907, Pt. I; 1908, Pt. I; 1909, Pt. I; 1912, Pt. I. Min. Res. W. of Rocky Mts., 1874, 1875, 1876.

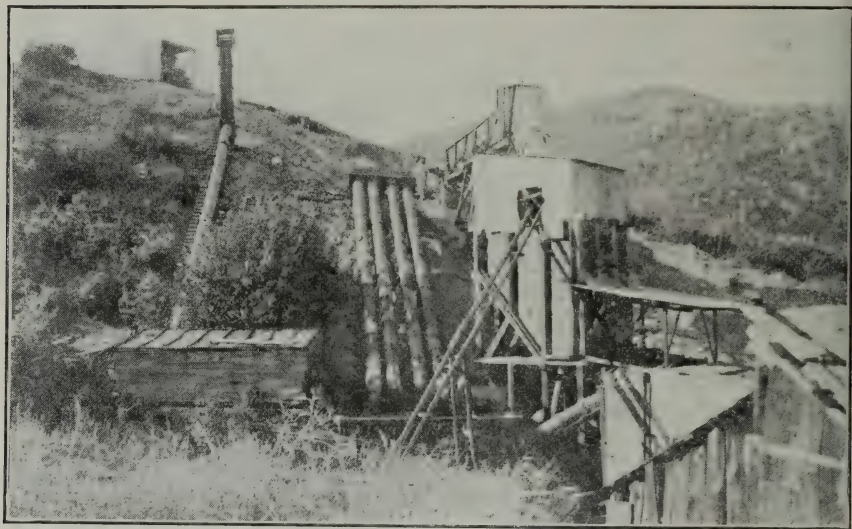
*Hays Mine* near Middletown has been idle for many years.

*Helen Mine* (Dead Broke, American) is in Sec. 1, T. 10 N., R. 8 W., six miles west of Middletown, and is assessed to Andrew Rocca of Calistoga. H. W. Gould, Mills Building, San Francisco, is reported to have purchased the property recently. The first recorded production of the mine was 128 flasks in 1873. The vein occurs on the contact of serpentine with sandstone and slate, and has a prominent outcrop. In 1918, the recorded production was something over 6000 flasks. In 1927, the *Mineral Mountain Company* produced 13 flasks. Before this, the *Pacific Coast Mines Development Company* operated the mine for a time. At the time of visit, L. S. Peterson, C. S. Peterson and E. R. Vandebeck of Middletown were operating the property under a lease. They had produced 50 flasks of quicksilver from about 650 tons of ore.

The mine has been opened by means of three main tunnels, the lower of these being 2000 feet long and giving a depth of 316 feet below the outcrop. This lower tunnel has caved. In the upper workings, lessees had driven 80 ft. of new development work, and had cleaned out 400 ft. of old workings; but no important body of new ore was found. Part of their ore has come from these upper workings, and part from dumps.

Reduction equipment includes a Dodge crusher to reduce the furnace feed to 2-inch size, a 30-ton Gould rotary furnace, 40 by 3 ft., and inclined condensers made of sewer tile. A good idea of these condensers may be obtained from the photograph. A 10-h.p. Fairbanks-Morse Y type oil engine drives the furnace and the small compressor that supplies the oil burners. Compressed air for the mine is supplied by a 9 by 8-inch compressor driven by a Fairbanks-Morse Type NE oil engine of 25 h.p. The soot from the sewer-tile condensers is treated in a 'D' retort.

Bibl: State Mineralogist's Reports XII, p. 362; XIV, pp. 231-233; XVII, p. 81; Chapter rep. bien. period, 1913-1914, pp. 59-61; Bull. 27, pp. 55-57; Bull. 78, pp. 59-61; Reg. of Mines, Lake Co., p. 3. U. S. G. S., Mon. XIII, p. 375; Min. Res. 1902; 1907 Pt. I; 1908, Pt. I; 1909, Pt. I; 1911, Pt. I, p. 901; 1912, Pt. I,



Reduction plant at Helen Mine.

pp. 940-942; 1915, Pt. I, p. 269. Min. Res. W. of Rocky Mts., 1874, p. 30. Geol. Surv. of Cal., Geol. Vol. I, p. 89.

*Hunt Prospect* is in Sec. 14 or 15, T. 10 N., R. 7 W., adjoining the Mirabel near Middletown, and is owned by Moss Hunt of Middletown, who has been doing some development work on it.

*Jewess Prospect* (see *Wall Street*).

*Lucitta Mine* (Uncle Sam) is in Secs. 20 and 21, T. 13 N., R. 8 W., about seven miles southeast of Kelseyville. John L. Jago has recently bought it for taxes, and has done some work on the cinnabar showings. Bradley<sup>1</sup> has described the formations as follows:

"The formation, here, is mainly igneous, boulders of andesites being prominent, the intervening material being a decomposed tuff bleached by solfataric action. White beds of leached metamorphic shales are found in these igneous masses, and

<sup>1</sup> Op. cit.



occasional bodies of clay. In the lower tunnel cinnabar has been deposited on the face of the boulders of ore. A small prospect opening near the dump of Tunnel No. 2 showed solfataric action, and formations similar to those at the surface at the Sulphur Bank Mine."

Bibl: State Mineralogist's Reports V, p. 96; XIV, p. 233; Chapter rep. bien. period, 1913-1914, p. 61; Bull. 27, p. 58; Bull. 78, p. 61; Reg. of Mines, Lake Co., p. 3.

*Maypole Prospect*, seven miles west of Middletown, has been abandoned.

Bibl: State Mineralogist's Reports XIII, p. 596; XIV, p. 233; Chapter rep. bien. period, 1913-1914, p. 61.

*Middletown Prospect*, half a mile southwest of the Jewess, has been abandoned.

Bibl: State Mineralogist's Report XIV, p. 233; Chapter rep. bien. period, 1913-1914, p. 61; Bull. 27, p. 59.

*Mirabel Mine* (Bradford) is in Secs. 14 and 23, T. 10 N., R. 7 W., four miles south of Middletown. The State highway crosses the property; and Calistoga is 14 miles south by this road. The owner is the *Mirabel Park Association*, c/o F. O. Jones, R. 3, Box 1338, Napa, California. H. C. & L. H. Davey and John W. Doman have a lease and option to purchase. 760 acres are held under the old Bradford patents. For ten years, 1887-1897, it was one of the important producers, and is credited with a production of 30,600 flasks.

In 1897, the ore was thought to be worked out; and the mine was abandoned. Small amounts of quicksilver were produced in later years from the dumps and from cleaning the old furnace.

Lessees have equipped the mine with a 210-cu. ft. hot-head compressor, a 420-cu. ft. Sullivan angle-compound compressor driven by electric motor, 5-hp. gasoline hoist, 25-hp. electric hoist to replace the gasoline hoist, machine drills and a No. 8 Waugh drill-sharpener. At the time of visit 40 men were employed in prospecting in an open cut and in driving crosscuts from the bottom of a shaft 75 ft. deep. These crosscuts had been driven south 70 ft., east 80 ft. and north 40 ft. Some work was being done around the old Scott furnace, also, but during the winter the force was to be reduced to only a few men to continue prospecting. Ore exposed in the open cut was deposited in small fractures in opaline quartz in serpentine.

940 tons of ore from the workings described had just been run through the old Scott furnace, which has a capacity of 48 tons per 24 hours. The furnace burns  $1\frac{1}{2}$  cords of manzanita and oak wood per 24 hours. Ore is hauled from the mine over  $\frac{3}{4}$  mile of road to a No. 3 gyratory crusher near the furnace, is crushed to one-inch size, and is then elevated to the furnace. The cleanup from this run was being made at the time of visit, but had not yet been finished.

Bibl: State Mineralogist's Reports VIII, p. 325; X, p. 270; XI, p. 64; XII, p. 361; XIII, p. 595; XIV, p. 233; Chap. rep. bien. period, 1913-1914, p. 61; Reg. of Mines, Lake Co., p. 3; Bull. 27, pp. 60-61; Bull. 78, p. 62. U. S. G. S. Mon. XIII, p. 375; Min. Res. 1888, p. 97; 1891, p. 117; 1892, p. 160. Trans. A. I. M. E. XXII, p. 86.



*Red Elephant Prospect* is in Sec. 3, T. 11 N., R. 5 W., one-half mile west of Knoxville in Napa County, but is reached by road from Lower Lake. Rights to several unpatented claims are held by the Red Elephant Quicksilver Mining Company, 325 Monadnock Building, San Francisco, M. M. Getz, secretary. F. D. Sanders of 1121 Bush Street, San Francisco, is operating the property under a five-year lease. 50 feet of new development work, including a winze 12 ft. deep, has been done from a tunnel that taps the workings from an old shaft four feet below the 55-ft. level. A 108-ft. level from this old shaft is under water, and has not been reopened. Stringers from one to two inches wide containing cinnabar are exposed in the workings; and the country rock is serpentine.

A 20-ton Thompson reduction plant similar to that at the Bella Oaks<sup>2</sup> mine in Napa County has been installed. The rotary furnace is 4 ft. 6 in. in diameter by 16 ft. long; and the condenser is a 6000 gal. wooden tank, divided vertically into four compartments, in which horizontal baffles are placed and loaded with cobblestones. Water is fed to this condenser through holes in the top. A fan placed on top of the brick dust chamber sucks from this, and blows into the condenser. A 20,000-gallon oil tank and two pipe retorts 12 inches by 6 ft. are included in the equipment. Seven men were at work at the time of visit, three furnacemen, one carpenter, two miners and a cook. Production of the new plant had amounted to six flasks of quicksilver.

Bibl: State Mineralogist's Reports XIV, p. 234; XVII, p. 82; Chapter rep. bien. period, 1913-1914, p. 62; Bull. 27, p. 92; Bull. 78, p. 62; Reg. of Mines, Lake Co., p. 3.

*Red Rock & Silver Rock Claims* are in Sec. 17, T. 12 N., R. 6 W., five miles from Lower Lake near the Baker mine. Years ago, a small amount of development work was done on an ocherous ledge 10 ft. wide containing cinnabar.

Bibl: Cal. State Min. Bur. Bull. 78, p. 63.

*Rich Hill Prospect* is in Sec. 19, T. 10 N., R. 6 W., southeast of Middletown near the Oat Hill mine. Cinnabar occurs in sandstone.

Bibl: Cal. State Min. Bur. Bull. 78, p. 63.

*Shamrock Prospect* is in Sec. 23, T. 13 N., R. 6 W., about 10 miles northeast of Lower Lake. Nothing has been done here recently.

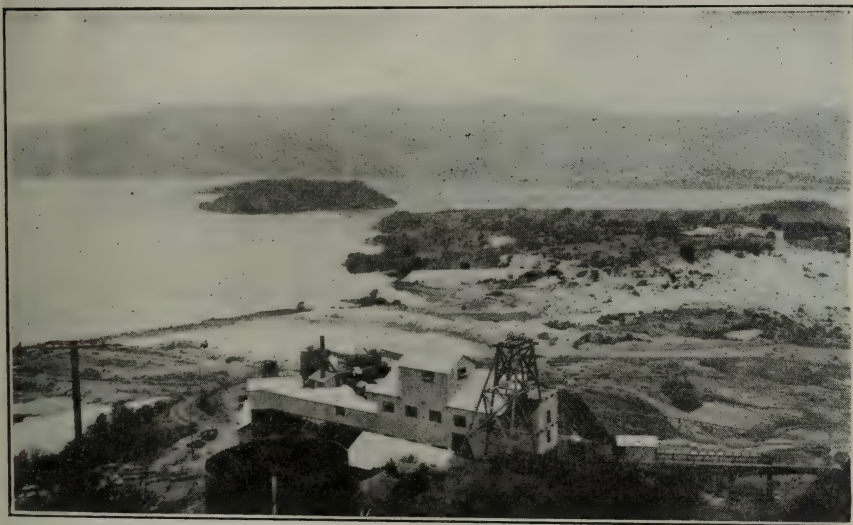
Bibl: State Mineralogist's Report XIV, p. 234; Chapter rep. bien. period, 1913-1914, p. 62; Bull. 27, p. 60; Reg. of Mines, Lake Co. p. 3.

*Sulphur Bank Mine* is in Sec. 6, T. 13 N., R. 7 W., about 10 miles north of Lower Lake or 42 miles north of Calistoga. The road is good, except that the last few miles are likely to get soft in wet weather. The present owner is the Sulphur Bank Syndicate, 1022 Crocker Building, San Francisco, of which F. W. Bradley is president and E. A. Griffen is secretary. At the mine W. Bradley is superintendent

<sup>2</sup> See page 228, *ante*.

and W. H. Enderton is engineer. Clearlake is the name of the post office serving the mine.

The mine is famous as an example of a place in which ore deposition is going on at the present time; and, in this connection, it has been studied by several well known geologists. Sulphur was the original product; and nearly two million pounds valued at \$53,500 were produced between 1865 and 1868. The California Borax Company owned the property at that time; and was producing borax from Borax Lake during the same period. As the workings deepened, it was found that the sulphur contained increasing amounts of cinnabar, which darkened the product. Cost of transportation and a fall in price of sulphur made the production of that mineral unprofitable; and the mine was idle until 1873, when it was developed for quicksilver. A steady and important production of the liquid metal was made for 10 years;



Sulphur Bank Mine.

Flotation plant in foreground; quicksilver deposit in middle distance.

and then periods of idleness alternated with periods of production down to the present time.

The ore on the surface is a replacement of basalt; but underground it is found in the underlying Quarternary lake beds and Tertiary metamorphics. Blocks of basalt have been decomposed by the hot solutions in concentric layers, so that the resulting boulders are well rounded. Some of the dumps have the appearance of tailings from a placer mine; but the whole mass is covered with a white, powdery material that has resulted from the decomposition and leaching of the basalt by the hot solutions. Hot water with gases bubbling through can be observed in many places in the deposit; and the odors of sulphur dioxide and hydrogen sulphide are strong. The sulphur of the deposit has been formed either from the oxidation of hydrogen sulphide or by the reaction of sulphur dioxide with hydrogen sulphide. Le Conte, Rising,

Becker and Posepny<sup>1</sup> have studied these hot sodium carbonate and borate waters and the deposits made by them, and all have come to the conclusion that the deposition of cinnabar, sulphur, pyrite and opal is actually taking place. The following extracts are quoted from Becker:†

"The gases escaping from the waters are carbon dioxide, hydrogen sulphide, sulphur dioxide, and marsh gas. The waters contain chiefly carbonates, borates,



Sulphur Bank Mine.

Flotation plant in foreground with inclined tramway and headframe to raise ore from lower bin to top of mill. Furnace plant in center. Power shovel at work on tailings in right middle distance.

and chlorides of sodium, potassium, and ammonium; but alkaline sulphides are also present."

"It (cinnabar) does not occur in sensible quantities at or near the surface, but is found to a considerable extent mixed with sulphur in the lower portion of the zone of oxidation. The principal deposits are below this level. They are found in the more or less decomposed basalt, in the underlying recent lake bottom, and in the Knoxville shales and sandstones. The cinnabar is associated chiefly with silica, in part crystalline and in part amorphous. In the lava it appears as small seams, which commonly follow either the original cracks between the blocks or the concentric surfaces of the decomposed masses. In the lake deposits below the basalt the cinnabar is found as impregnations or irregular seams. In the workings from the Herman shaft the ore occurs exactly as it does in most of the quicksilver mines of California, more or less completely filling the interstices in shattered rock masses.

\* \* \* Dr. Melville has found small quantities of gold and copper in the marcasite accompanying the cinnabar. \* \* \* The intimate association of the ore with the sulphur, opal, quartz, pyrite, and to a smaller extent with calcite, is amply sufficient to show that it has been deposited from water."

"Excepting for the solfataric springs the underground mine at Sulphur Bank resembles the other principal quicksilver mines of California. \* \* \* This fact is an important one, for it proves that deposits indistinguishable from those found in the Redington, New Almaden, and other mines may be formed in the same manner as those at Sulphur Bank, by precipitation from hot springs of volcanic origin."

Extraction of the quicksilver was formerly accomplished with a Knox-Osborne 25-ton furnace, three Hunter-Scott furnaces of 40, 17 and 30 tons capacity, respectively, and a battery of nine 'D' retorts. In 1917, some experiments were made with table concentration, much of the coarser material being rejected immediately by a grizzly in a

<sup>1</sup> G. F. Becker, U. S. G. S. Mon. XIII, 1888, Chap. VII.

J. LeConte and W. B. Rising, The phenomena of metalliferous vein formation now in progress at Sulphur Bank, Cal., Am. Jour. Sci., 3d ser., vol. 24, 1882, pp. 23-33.

F. Posepny, The genesis of ore deposits, 2d ed., 1902, pp. 32-36.

† Op. cit., pp. 463, 257, 263.



manner similar to the operation of the trommel in the plant recently built. The cinnabar is deposited in the fractures and concentric layers around the boulders of basalt; and the core is unaltered basalt, which is of no value. The idea is to reject these coarse pieces of waste, but to save all of the fine material, some of which has a tendency to adhere to them. The present plant is designed to accomplish this. Bradley<sup>1</sup> has described the former operations, using table concentration, in some detail.

The present operators have sampled and tested the deposit, and are satisfied that several hundred thousand tons of surface material, tailings and dumps can be treated in the new plant at a profit. Power shovels with Diesel engine drive and buckets of one cubic yard capacity are used for mining. Two of these are in use; and each carries a compressor capable of supplying air for a machine drill. At the time of visit (November, 1928), ore mined by these shovels was being treated in a new rotary furnace plant of 70 tons daily capacity. This furnace differs from the majority of those recently installed, in that the ore is fed to the same end that contains the oil burner. Both Cottrell and cyclone dust precipitators are being used. Condensers are sewer-tile and large wood-stave tanks; and a spray of cooling water is used inside of them. The product of these condensers (soot) is all retreated



Sulphur Bank Mine.

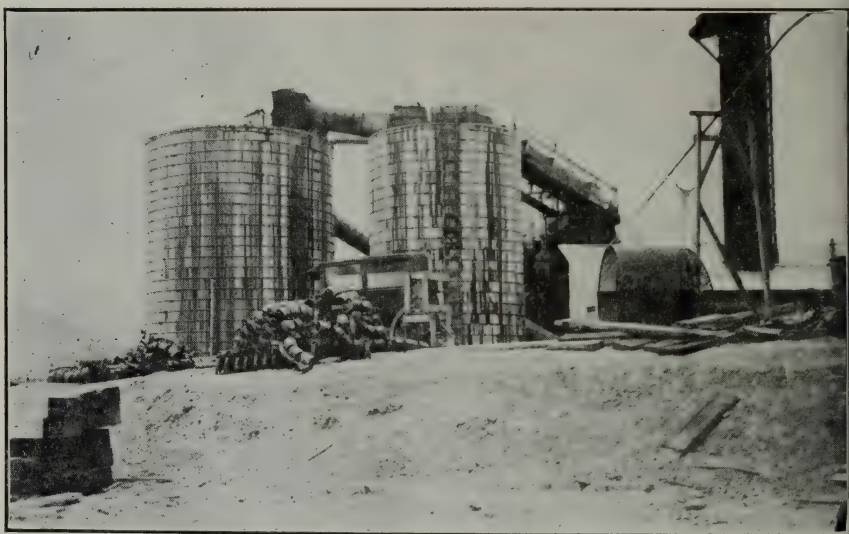
Ruins of old furnaces, with new plant above.

in retorts. Three and a half flasks of quicksilver per day were being produced at this plant.

A screening and flotation plant was under construction at the time of visit, and was expected to be in operation by the end of 1928. According to the best information obtainable at the property, this will

<sup>1</sup> Bradley, Walter W., Quicksilver Resources of California, Cal. State Min. Bur. Bull. 78, p. 346, 1918.

operate about as follows: 500 tons of ore per day will be delivered by truck to a bin below the plant at about the same elevation as the deposit. A 100-h.p. Allis-Chalmers double-drum hoist will raise the ore along an inclined tramway (see photograph) from the lower bin to the top of the plant. Ore will then pass through a trommel with opening about 2 inches in diameter. Oversize will be largely rejected and stacked by means of a belt conveyor; but provision has been made for hand-sorting chunks of ore from this reject before it leaves the plant. Chunks of good ore thus sorted will be crushed in an Allis-Chalmers crusher, 10 by 12 in., from which the crushed ore will be elevated to the screens. Undersize from the trommel will go to two revolving screens, each with a different size punching, the smaller being about  $\frac{1}{2}$  inch. Oversize from the screens can be sent to the present furnace plant, for which it will make a much better feed than



Wooden condensers at Sulphur Bank Mine.

that ordinarily used. Fines will be practically eliminated by the screens, which should keep the formation of dust in the furnace at a minimum. Undersize from the screens will go to the flotation plant, where it will be ground in a Hardinge ball mill, 8 ft. by 36 in., with Dorr classifier. Feed to the flotation plant is expected to amount to 150 or 200 tons per day. Flotation equipment consists of 12 Minerals Separation cells of a width of 2 ft. 9 inches. Possibly the concentrate from the first three or four cells will be of a high enough grade to go directly to the retorts; and lower grade concentrate will be treated in the furnace. An Oliver filter 5 ft. 4 in. by 8 ft. will be used for dewatering. Many details of operation will, no doubt, be changed from time to time in the plant, which is flexible enough to accommodate many combinations of screening and concentration by flotation.

Water is pumped to the plant from Clear Lake; and power is obtained from the Pacific Gas and Electric Company. Tailings are



mpounded in ponds built with tractor and scraper about a half mile inland from Clear Lake. 65 men were employed at an average wage of \$5.30 per day.

Bibl: State Mineralogist's Reports IV, pp. 157, 330, 336, 339; V, p. 96; VI, Pt. I, p. 136; VIII, p. 324; X, pp. 238, 239; XI, p. 63; XII, p. 363; XIII, p. 597; XIV, pp. 234-238, 240; XVII, p. 82; Chapter rep. bien. period, 1913-1914, pp. 62-66, 68; Bull. 27, pp. 61-70; Bull. 78, pp. 63-68; Reg. of Mines, Lake Co., p. 3. U. S. G. S. Mon. XIII, pp. 251-270, 463; Min. Res., 1883, pp. 394-397; 1884, p. 492; 1892, pp. 146, 148, 160; 1902, pp. 251, 252; Water Sup. Pap. 338, pp. 98-99. Geol. Survey of Cal., Geol., Vol. I, p. 99. Trans. A. I. M. E., XXIII, pp. 225 *et seq*; XXXIII, p. 751; Genesis of Ore Dep., pp. 32, 66, 256. Min. Res. W. of Rocky Mts., 1868, p. 266; 1876, p. 20. Am. Jour. of Sci., Vol. XXIV, 3d Ser., pp. 23 *et seq*.

*Thorn Mine* (Bear Canyon) is in Sec. 36, T. 11 N., R. 8 W., about one mile south of the Big Chief mine. Rose E. Anderson of Middletown holds 20 acres here; and additional ground is held by Charles Thorn and Dave Thorn of Middletown. The property is developed by a tunnel 200 or 300 feet long. About 500 flasks of quicksilver have been produced with pipe retorts. Nothing but assessment work has been done recently.

Bibl: State Mineralogist's Report XIV, p. 239; Chapter rep. bien. period, 1913-1914, p. 66; Bull. 27, p. 70; Bull. 78, p. 68. U. S. G. S. Min. Res. 1909, Part I, p. 552.

*Utopia Mine* is in Sec. 25, T. 15 N., R. 9 W., on the eastern shore of Clear Lake near Bartlett landing, northeast from Lakeport. Nothing has been done here recently. The ore is said to have been followed out under the lake until the water became troublesome.

Bibl: State Mineralogist's Reports XIII, p. 597; XIV, p. 239; Chapter rep. bien. period, 1913-1914, p. 67; Bull. 27, p. 70; Bull. 78, p. 69; Reg. of Mines, Lake Co., p. 3.

*Wall Street Mine* is in Sec. 1, T. 10 N., R. 8 W., on a branch of Dry Creek, six miles west of Middletown. Claims called the Wall Street Mine, Cinnabar Lode, Commercial, Jewess, and Dunham stand in the name of Abner M. Munger, on the books of the county assessor, but are to be deeded to the State for delinquent taxes in 1931. The property is a half mile down the canyon from the Helen mine; and the ore bodies have been considered faulted segments of those found at the Helen. W. H. Parsons, who acquired the property in 1898, worked the mine single-handed for several years, producing a few flasks of quicksilver annually. The *American Quicksilver Company* built a small rotary furnace, and is reported to have produced about 60 flasks of quicksilver from the Jewess claim in 1926. This furnace, of 15-ton capacity, with vertical condensers of sewer tile, is on the property. Judging from the appearance of the equipment, the last operation consisted of crushing ore in two stages with two crushers driven by a 15-h.p. Fairbanks-Morse Type Z oil engine, grinding in a multiple cylinder rod mill, and concentrating on an Overstrom table.



The mine has been idle for more than a year; and it was deserted at the time of visit.

Bibl: State Mineralogist's Reports IV, p. 183; V, p. 96; VI, Pt. I p. 110; XII, p. 362; XIII, p. 597; XIV, p. 239; XVII, p. 82 Chapter rep. bien. period, 1913-1914, p. 67; Bull. 27, p. 71 Bull. 78, p. 69; Reg of Mines, Lake Co., p. 3. U. S. G. S. Mon. XIII, p. 375; Min. Res. 1907, Pt. I, p. 679; 1908, Pt. I, p. 686 1909, Pt. I, p. 552; 1910, Pt. I, p. 698; 1911, Pt. I, p. 901; 1912 Pt. I, p. 940. Geol. Surv. of Cal., Geol. Vol. I, p. 89.

*White Elephant Prospect* (King of All Group) is in Secs. 29 and 32 T. 12 N., R. 7 W., about 10 miles north of Middletown, and one mile southeast of Howard Springs. No recent activity has been reported from this prospect.



View from Helen mine looking toward property of Wall Street mine.

Bibl: State Mineralogist's Report XIV, p. 233; Chapter rep. bien. period, 1913-1914, p. 61; Bull. 27, p. 57; Bull. 78, p. 70; Reg of Mines, Lake Co., p. 3. U. S. G. S. Min. Res. 1912, Pt. I, p. 940

#### STONE INDUSTRY

With the exception of gravel and crushed rock produced locally for use on the roads, Lake County produces practically no stone. The county clerk reports a production for surfacing roads in 1928.

#### SULPHUR

*Sulphur Bank Mine* (see under *Quicksilver*). A few notes on the early sulphur production of this mine have been given above. Much sulphur can be seen about the workings and hot springs at the present time, but it is not utilized in any way. On the other hand

he sulphur is an interfering element that causes trouble in the extraction of the quicksilver.

Bibl: State Mineralogist's Reports IV, p. 379; V, p. 96; VI, Pt. I, p. 136; VIII, p. 324; X, pp. 238-239; XI, p. 63; XII, p. 410; XIII, p. 646; Bull. 38, p. 372; Geol. Surv. of Cal., Geology, Vol. I, p. 99. U. S. G. S. Mon. XIII, pp. 254, 463; Min. Res. W. of Rocky Mts. 1867, p. 187; 1868, p. 266; 1872, pp. 447-450.

### LOS ANGELES FIELD DIVISION

W. BURLING TUCKER, Mining Engineer.

On account of unfinished field work there is no report from the Los Angeles Field Division in this issue.



## OIL FIELD DEVELOPMENT OPERATIONS

R. D. BUSH, State Oil and Gas Supervisor

From April 1, 1929, to and including June 29, 1929, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
<b>COLUSA COUNTY:</b>					
Calavada Superior Oil Co. ....	31	15	4	3	
Smith and Vickers .....	18	15	4	1	
<b>FRESNO COUNTY:</b>					
Currency Petroleum .....	14	21	14	1	Coalinga
Petroleum Securities Co. ....	20	20	16	Gatchell 1	Coalinga
Petroleum Securities Co. ....	28	20	16	Ladd 1	Coalinga
Section Thirty Oil Co. ....	30	19	15	2	Coalinga
Standard Oil Co. ....	33	21	17	21	Kettleman Hills
Standard Oil Co. ....	33	21	17	78	Kettleman Hills
Oceanside Oil Co. ....	33	22	16	2	
Shell Oil Co. ....	24	19	18	Boston Land	
				Co. A	
Shell Oil Co. ....	26	19	18	Boston Land	
				Co. B	
Shell Oil Co. ....	27	19	18	Boston Land	
				Co. C	
<b>KERN COUNTY:</b>					
Berry Oil Co. ....	30	28	21	30	Belridge
Berry Oil Co. ....	30	28	21	31	Belridge
The Ohio Oil Co. ....	30	28	21	25	Belridge
The Ohio Oil Co. ....	30	28	21	26	Belridge
The Ohio Oil Co. ....	30	28	21	27	Belridge
Don C. Aldridge .....	12	28	23	1	Buttonwillow Gas
Milham Exploration Co. ....	8	28	23	Crites 1	Buttonwillow Gas
Milham Exploration Co. ....	8	28	23	Kern 6	Buttonwillow Gas
W. Leland Foreman .....	6	30	23	Foreman 1	Elk Hills
Mohawk Petroleum Co. ....	27	29	27	4	Fruitvale
Mohawk Petroleum Co. ....	27	29	27	5	Fruitvale
Shell Oil Co. ....	5	29	27	Ansolabehere 1	Fruitvale
Taft Well Drilling Co. ....	1	30	27	Delfino 1	Fruitvale
Western Gulf Oil Co. ....	27	29	27	Switzer 1	Fruitvale
C. C. M. O. Co. ....	23	28	27	24	Kern River
C. C. M. O. Co. ....	23	28	27	25	Kern River
C. C. M. O. Co. ....	23	28	27	26	Kern River
General Petroleum Corp. ....	14	28	27	29	Kern River
General Petroleum Corp. ....	14	28	27	32	Kern River
General Petroleum Corp. ....	14	28	27	33	Kern River
General Petroleum Corp. ....	14	28	27	34	Kern River
General Petroleum Corp. ....	14	28	27	35	Kern River
Pan American Petroleum Co. ....	22	28	27	15	Kern River
Pan American Petroleum Co. ....	22	28	27	20	Kern River
Pan American Petroleum Co. ....	22	28	27	26	Kern River
Pan American Petroleum Co. ....	22	28	27	27	Kern River
Pan American Petroleum Co. ....	22	28	27	28	Kern River
Pan American Petroleum Co. ....	22	28	27	29	Kern River
Shell Oil Co. ....	1	25	19	McLennan 1	Kettleman Hills
Ozena Oil Co. ....	27	29	21	Kendon 2	McKittrick
C. C. M. O. Co. ....	7	32	23	8	Midway
Honolulu Consolidated Oil Co. ....	8	32	24	21	Midway
Honolulu Consolidated Oil Co. ....	8	32	24	32	Midway
Honolulu Consolidated Oil Co. ....	8	32	24	84	Midway
North American Oil Consolidated .....	30	31	24	48	Midway
North American Oil Consolidated .....	30	31	24	49	Midway
North American Oil Consolidated .....	2	32	23	21	Midway
Republic Petroleum Co. ....	7	32	23	35	Midway
Standard Oil Co. ....	29	31	24	17	Midway
Standard Oil Co. ....	1	32	23	221	Midway
Standard Oil Co. ....	1	32	23	244	Midway
Standard Oil Co. ....	5	32	24	12	Midway
Standard Oil Co. ....	5	32	24	14	Midway
Standard Oil Co. ....	7	32	24	115	Midway



## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>ERN COUNTY—Continued.</b>					
Standard Oil Co.	7	32	24	265	Midway
Union Oil Co.	22	32	23	Williams 1	Midway
Buttram Oil Co.	24	27	28	1	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21, 23	Mt. Poso
General Petroleum Corp.	21	27	28	Glide 21, 26	Mt. Poso
The Ohio Oil Co.	13	27	27	1	Mt. Poso
Petroleum Securities Co.	21	27	28	Glide 12	Mt. Poso
Petroleum Securities Co.	21	27	28	Glide 13	Mt. Poso
Petroleum Securities Co.	21	27	28	Glide 14	Mt. Poso
Petroleum Securities Co.	21	27	28	Glide 15	Mt. Poso
Petroleum Securities Co.	21	27	28	Glide 16	Mt. Poso
Petroleum Securities Co.	26	27	28	Gardner 1	Mt. Poso
Petroleum Securities Co.	35	27	28	Glide 35, 1	Mt. Poso
Shell Oil Co.	28	26	28	Knapp 1	Mt. Poso
The Texas Co.	4	27	28	Alta Vedder 2	Mt. Poso
Union Oil Co.	28	27	28	Tribe 2	Mt. Poso
Elbe Oil Land Development Co.	20	28	29	Freeman 4	Round Mountain
Honolulu Consolidated Oil Co.	34	28	29	1	Round Mountain
Petroleum Securities Co.	6	28	29	Coffee 1	Round Mountain
Petroleum Securities Co.	6	28	29	Coffee 2	Round Mountain
Fred M. Sayre	12	28	28	Sayre 1	Round Mountain
Shell Oil Co.	7	28	29	Caldwell 1	Round Mountain
Shell Oil Co.	19	28	29	Jewett 3-1	Round Mountain
Shell Oil Co.	29	28	29	Jewett 6	Round Mountain
Birch-Royer	7	11	23	1	Sunset
California Western Oil Co.	17	11	23	1	Sunset
Doyle Petroleum Corp.	8	11	23	Berta Wier 1	Sunset
North American Oil Consolidated	8	11	23	1	Sunset
North American Oil Consolidated	8	11	23	Bronco 1	Sunset
North American Oil Consolidated	18	11	23	Lincoln 1	Sunset
Rio Grande Oil Co.	22	11	23	1	Sunset
Signal Oil and Gas Co.	8	11	23	3	Sunset
Signal Oil and Gas Co.	8	11	23	4	Sunset
Standard Oil Co.	7	11	23	Graham 1	Sunset
Fred D. Turner	10	11	23	1	Sunset
K. C. Wallace	8	11	23	Signal-Wallace 1	Sunset
J. H. Kennedy	5	29	20	1	Temblor
Calkern Oil Co., Inc.	18	28	22	1	
Day Oil Co.	1	27	18	1-A	
A. Bruce Frame	21	26	28	Bowles 1	
General Petroleum Corp.	25	26	25	KCL 25, 1	
The Ohio Oil Co.	20	32	25	1	
<b>KINGS COUNTY:</b>					
Associated Oil Co.	34	22	18	Watson 1	Kettleman Hills
Bolsa Chica Oil Corp.	32	23	19	Downing 32-1	Kettleman Hills
C. C. M. O. Co.	28	24	19	Sahlein 1	Kettleman Hills
George F. Getty, Inc.	6	22	18	Armstrong 6-1	Kettleman Hills
Petroleum Securities Co.	14	22	17	Robinson 1	Kettleman Hills
Petroleum Securities Co.	24	23	18	Malmsbury 1	Kettleman Hills
Shell Oil Co.	28	23	19	Fay 1	Kettleman Hills
Standard Oil Co.	35	21	17	38	Kettleman Hills
Standard Oil Co.	3	22	17	87	Kettleman Hills
Standard Oil Co.	11	22	17	261	Kettleman Hills
Standard Oil Co.	11	22	17	Gas Injection	
				test 1	Kettleman Hills
Standard Oil Co.	13	22	17	87	Kettleman Hills
Standard Oil Co.	17	22	18	21	Kettleman Hills
Standard Oil Co.	17	22	18	58	Kettleman Hills
Standard Oil Co.	35	22	18	2	Kettleman Hills
Kellenberger and Kesselman	24	21	18	1	
Shell Oil Co.	17	19	19	Boston Land	
				Co. D	
<b>LOS ANGELES COUNTY:</b>					
Standard Oil Co.	5	2	14	Freeman 1	Inglewood
Standard Oil Co.	17	2	14	L. A. Investment 1-60	Inglewood
Shell Oil Co.	20	3	14	Bowman 1	Lawndale

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Smith Development Co.....	20	3	14	8	Lawndale
Allied Petroleum Corp.....	19	4	12	Garrison 1	Long Beach
L. E. Bishop Oil Co.....	13	4	13	1	Long Beach
Bush-Voorhis Oil Co.....	19	4	12	25	Long Beach
Continental Oil Co.....	19	4	12	Taylor 2	Long Beach
Dabney-Johnston Oil Corp.....	13	4	13	38	Long Beach
Dabney-Johnston Oil Corp.....	13	4	13	39	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	37	Long Beach
Dabney-Johnston Oil Corp.....	24	4	13	40	Long Beach
D. D. Dunlap.....	24	4	13	2	Long Beach
Fred F. Fitch.....	24	4	13	Fitch-Lang 1	Long Beach
Graham-Loftus Oil Corp.....	19	4	12	Davis 1	Long Beach
Graham-Loftus Oil Corp.....	24	4	13	Del Mar 1	Long Beach
Graham-Loftus Oil Corp.....	24	4	13	Del Mar 2	Long Beach
Graham-Loftus Oil Corp.....	24	4	13	Dodge 2	Long Beach
Hancock Oil Co.....	19	4	12	Signal 19	Long Beach
Otis Hoyt.....	19	4	12	3	Long Beach
Otis Hoyt.....	19	4	12	4	Long Beach
Otis Hoyt.....	19	4	12	5	Long Beach
A. T. Jergins Syndicate, Inc.....	13	4	13	6	Long Beach
A. T. Jergins Trust.....	19	4	12	26	Long Beach
A. T. Jergins Trust.....	19	4	12	27	Long Beach
A. T. Jergins Trust.....	19	4	12	28	Long Beach
MacMillan Petroleum Corp.....	24	4	13	10	Long Beach
Marine Corp.-Apex Petroleum Corp.....	19	4	12	16-A	Long Beach
Marine Corp.-Apex Petroleum Corp.....	19	4	12	17-A	Long Beach
W. F. Meyer.....	19	4	12	4	Long Beach
W. F. Meyer.....	24	4	13	Meyer 3	Long Beach
Miley Oil Co.....	19	4	12	Mills 7	Long Beach
Pannill Drilling Co.....	24	4	13	1	Long Beach
Pannill Drilling Co.....	24	4	13	2	Long Beach
Petroleum Securities Co.....	29	4	12	Davis-	
Petroleum Securities Co.....	13	4	13	MacMillan 1	Long Beach
Petroleum Securities Co.....	24	4	13	Bixby 1	Long Beach
Petroleum Securities Co.....	24	4	13	Duncan 1	Long Beach
Shell Oil Co.....	29	4	12	Janich 1	Long Beach
Strader Oil Co.....	13	4	13	Stakemiller 7	Long Beach
The Texas Co.....	19	4	12	1	Long Beach
Warren and Macrate.....	19	4	12	Foster 1-5	Long Beach
Western Oil and Refining Co.....	19	4	12	Neet 3	Long Beach
Woolner Oil Corp.....	19	4	12	Dutcher 2	Long Beach
Montebello Trust No. 1.....	1	2	12	Signal Hill 6	Long Beach
Standard Oil Co.....	36	1	12	1	Montebello
Standard Oil Co.....	3	2	12	Stocker-	
Standard Oil Co.....	3	2	12	Merced 3	Montebello
Standard Oil Co.....	3	2	12	Monterey Park	
Standard Oil Co.....	3	2	12	Land Co. 1	Montebello
Standard Oil Co.....	3	2	12	Whitehead	
W. H. Taylor.....	32	1	12	Comm. 4	Montebello
J. M. Queen.....	22	3	16	1	Montebello
Southern California Drilling Co.....	13	3	16	1	Newhall
Associated Oil Co.....	34	2	14	Needham 1	Newhall
Cypress Petroleum Co.....	34	2	14	Pacific	
Midland Petroleum Co.....	33	2	14	Southwest 2	Potrero
Petroleum Securities Co.....	28	2	14	deKoch 1	Potrero
San Patricio Oil Co., Ltd.....	26	2	14	Peterson 1	Potrero
Barnsdall Oil Co.....	20	3	13	Parent 1	Potrero
Associated Oil Co.....	6	3	11	Connolly 1	Potrero
H. A. Bardeen.....	6	3	11	Rosecrans 3-A	Rosecrans
Commodore Petroleum Co.....	5	3	11	Dewenter 8	Santa Fe Springs
The Elmer Co.....	6	3	11	Santa Fe 3	Santa Fe Springs
The Elmer Co.....	6	3	11	Landl 5	Santa Fe Springs
General Petroleum Corp.....	5	3	11	2	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Jameson 1	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 129-A	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 136-A	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 137-D	Santa Fe Springs

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
General Petroleum Corp.....	5	3	11	Santa Fe 143-A	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 145-D	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 145-E	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 145-F	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 146-C	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 152-H	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 161-C	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 168-E	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 168-F	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 237	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 240	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Hill-Midway 105	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 177-E	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 178-C	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 179-H	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 185-D	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 185-E	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 186-H	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 186-K	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	
				Comm. 191-F	Santa Fe Springs
George F. Getty, Inc.....	5	3	11	S.F.S. 37	Santa Fe Springs
George F. Getty, Inc.....	5	3	11	S.F.S. 38	Santa Fe Springs
George F. Getty, Inc.....	5	3	11	S.F.S. 39	Santa Fe Springs
Richfield Oil Co.....	5	3	11	Howard 5	Santa Fe Springs
Rohde Oil Syndicate No. 3.....	6	3	11	Rohde 3	Santa Fe Springs
Shell Oil Co.....	31	2	11	G.H.N. 23	Santa Fe Springs
Shell Oil Co.....	31	2	11	G.H.N. 24	Santa Fe Springs
Shell Oil Co.....	6	3	11	G.H.N. 22	Santa Fe Springs
Standard Oil Co.....	5	3	11	South Whittier	
				Comm. 28	Santa Fe Springs
The Texas Co.....	6	3	11	Weaver 8	Santa Fe Springs
Union Oil Co.....	6	3	11	Alexander 18	Santa Fe Springs
Union Oil Co.....	6	3	11	Alexander 19	Santa Fe Springs
Union Oil Co.....	6	3	11	Bell 48	Santa Fe Springs
Union Oil Co.....	6	3	11	Bell 49	Santa Fe Springs
Union Oil Co.....	6	3	11	Bell 50	Santa Fe Springs
Union Oil Co.....	6	3	11	Bell 51	Santa Fe Springs
Wilshire Annex Oil Co.....	6	3	11	Crawford 1	Santa Fe Springs
Wilshire Annex Oil Co.....	6	3	11	Crawford 2	Santa Fe Springs
Marland Oil Co.....	2	5	12	Bixby 28	Seal Beach
Marland Oil Co.....	3	5	12	McGrath and	
				Selover 18	Seal Beach
Marland Oil Co.....	3	5	12	McGrath and	
				Selover 21	Seal Beach
Marland Oil Co.....	11	5	12	Bixby 14	Seal Beach
Marland Oil Co.....	11	5	12	Bixby 29	Seal Beach
Standard Oil Co.....	3	5	12	San Gabriel 23	Seal Beach
Allied Petroleum Corp.....	28	3	14	Lincoln 1	
G. F. Beard.....	30	2	9	Brea Canyon	
				Heights 1	
Hancock Oil Co.....	22	3	14	Alondro 1	
Joseph Hummel.....	28	3	14		1
Mohawk Petroleum Co.....	29	3	14	Towell 1-A	
Rucker, Smith and Croul.....	27	2	10		1
The Texas Co.....	8	4	12	Montana Land	
				Co. 1	
MENDOCINO COUNTY:					
The Twin State Oil Co.....	14	12	17		1



## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>MONTEREY COUNTY:</b>					
W. F. Broun.....	15	23	14	1	
Union Oil Co.....	8	22	8	Page 1	
<b>ORANGE COUNTY:</b>					
Brea Canon Oil Co.....	2	3	10	46	Brea-Olinda
Standard Oil Co.....	13	3	11	Emery 43-A	Coyote Hills
American Oil Producers, Ltd.....	2	6	11	Grant-Neis-	
				wender 1	Huntington Beach
F. E. Bundy.....	11	6	11	Camp Ground 2	Huntington Beach
Rex Oil Co.....	2	6	11	12	Huntington Beach
Standard Oil Co.....	2	6	11	Huntington B 62	Huntington Beach
Texas Holding Co.....	2	6	11	5	Huntington Beach
V. R. G. Wilbur.....	2	6	11	1	Huntington Beach
Continental Oil Co.....	33	3	9	Krause 1	Richfield
Continental Oil Co.....	33	3	9	Mondotte 1	Richfield
Continental Oil Co.....	33	3	9	Pyne 7-A	Richfield
Continental Oil Co.....	33	3	9	Santa Fe 2	Richfield
Continental Oil Co.....	33	3	9	Stearn 1	Richfield
Federal Oil Co.....	28	3	9	Davenport	
				Comm. 2	Richfield
Superior Oil Co.....	33	3	9	Guarantee 1	Richfield
Superior Oil Co.....	33	3	9	Guarantee 2	Richfield
Superior Oil Co.....	33	3	9	Jeason 1	Richfield
Superior Oil Co.....	33	3	9	Mosley 1	Richfield
General Petroleum Corp.....	13	3	9	Rimpau 1	
Shell Oil Co.....	28	3	10	Bastanchury 1	
<b>SAN BERNARDINO COUNTY:</b>					
Urmi Oil Co.....	31	2	8	Marie 1	
<b>SAN DIEGO COUNTY:</b>					
Borderland Exploration Co., Inc.....	Range	ho Las	Encin itas		
	Lot	21		1	
The MacGregor Corp.....	17	14	3	Butler 1-A	
<b>SAN LUIS OBISPO COUNTY:</b>					
McKeon Drilling Co., Inc.....	5	32	13	Elberta 2	Arroyo Grande
Dollar Oil Co.....	3	32	22	Kent and	
				McDonald 1	
Dollar Oil Co.....	3	32	22	Quinan 1	
Paso Robles Oil Trust.....		27	11	1	
N. S. Wilson.....	34	31	15	2	
<b>SANTA BARBARA COUNTY:</b>					
Barnsdall Oil Co.....	22	4	29	Luton-Bell 7	Elwood
Barnsdall Oil Co.....	23	4	29	Doty 5	Elwood
Pacific Western Oil Co.....	16	4	29	1	Elwood
Petroleum Securities Co.....	30	4	28	Bishop 1	Elwood
Petroleum Securities Co.....	12	4	29	Pomatto A-1	Goleta
American Oil Developers, Ltd.....	21	4	26	1	Summerland
Lincoln Drilling Co.....	21	4	26	1	Summerland
Scott Bros. Well Drilling Co.....		4	26	1	Summerland
Altadena Oil Co.....	29	4	27	1	
Altadena Oil Co.....	29	4	27	2	
Robert Bowles Oil Co.....	29	4	27	5	
Coffman Oil Co., Ltd.....	29	4	27	1	
E. E. Combs and A. J. Odell.....	29	4	27	10	
Continental Oil Co.....	33	4	25	Kittie C.	
				Bailard 1	
Craft Petroleum Corp.....	29	4	27	1	
Doyle Petroleum Corp.....	29	4	27	1	
Dunlap and Knapp.....	29	4	27	1	
Dunlap and Knapp.....	29	4	27	2	
Exeter Oil Co.....	29	4	27	1	
General Petroleum Corp.....	29	4	27	Mesa School 1	
General Petroleum Corp.....	29	4	27	Olympic-	
				Comm. 1	

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>ANTA BARBARA COUNTY</b>					
—Continued.					
General Petroleum Corp.....	29	4	27	Olympic-Comm. 2	
General Petroleum Corp.....	29	4	27	Olympic-Lomas 2	
General Petroleum Corp.....	29	4	27	Olympic-Palisades 1	
General Petroleum Corp.....	29	4	27	Wheeler 1	
General Petroleum Corp.....	21	4	28	More 1	
Keystone Petroleum Corp.....		7	35	1	
G. M. Knapp.....	29	4	27	1	
Major Oil Co.....	29	4	27	1	
Olympic Refining Co.....	29	4	27	Fee 1	
Louis B. O'Neil.....	26	8	33	1	
Pacific Western Oil Co.....	29	4	27	Palisades-Comm. 1	
Pacific Western Oil Co.....				Wylie 1	
E. A. Parkford.....	29	4	27	1	
Max Pray.....	29	4	27	2	
Wm. Rhoads.....	29	4	27	1	
Ring Oil Co.....	29	4	27	Nugent 1	
J. Orville Seeple.....	29	4	27	Seeple 1	
J. Orville Seeple.....	29	4	27	Seeple 2	
Shell Oil Co.....	25	10	35	Union Sugar A-3	
Shell Oil Co.....	25	10	35	Union Sugar A-5	
Shell Oil Co.....	36	10	35	Union Sugar A-4	
Union Oil Co.....		4	27	Carpenter-Wellman-Comm. 2	
Union Oil Co.....	29	4	27	Carpenter-Wellman-Comm. 1	
Union Oil Co.....	29	4	27	Durer 1	
Union Oil Co.....		7	31	Linus Buell 1	
Western Gulf Oil Co.....		5	33	Hollister 1	
<b>STANISLAUS COUNTY:</b>					
W. E. Randolph.....	20	3	13	1	
<b>VENTURA COUNTY:</b>					
Continental Oil Co.....	21	4	22	S.M.P. 3	Ojai
Bolsa Chica Oil Corp.....	4	4	18	Snow 1-A	Piru
C. C. M. O. Co.....	16	3	24	Hobson B-9	Rincon
Superior Oil Co.....	14	4	21	Kirtlan 14-1	Santa Paula
Pan American Petroleum Co.....	36	3	18	Tapo 42	Simi
The Texas Co.....	18	3	20	Willard 26	South Mountain
The Texas Co.....	13	3	21	Harvey 26	South Mountain
Associated Oil Co.....	22	3	23	Hartman 16	Ventura
Associated Oil Co.....	22	3	23	Lloyd 34	Ventura
Associated Oil Co.....	22	3	23	Lloyd 48	Ventura
Associated Oil Co.....	23	3	23	Lloyd 107	Ventura
Associated Oil Co.....	23	3	23	McGonigle 7	Ventura
Associated Oil Co.....	23	3	23	V. L. & W. 6	Ventura
Associated Oil Co.....	26	3	23	V. L. & W. 12	Ventura
Associated Oil Co.....	27	3	23	Lloyd 47	Ventura
Associated Oil Co.....	27	3	23	Lloyd 88	Ventura
Associated Oil Co.....	27	3	23	Lloyd 91	Ventura
Associated Oil Co.....	27	3	23	Lloyd 93	Ventura
Bolsa Chica Oil Corp.....	21	3	23	Louis Hartman 5	Ventura
California Ventura Oil Co.....	4	3	23	20	Ventura
Federal Oil Co.....	30	3	22	Sexton 1	Ventura
Shell Oil Co.....	28	3	23	Gosnell 34	Ventura
Shell Oil Co.....	28	3	23	Taylor 39	Ventura
Shell Oil Co.....	28	3	23	Taylor 42	Ventura
Shell Oil Co.....	28	3	23	Taylor 43	Ventura
Shell Oil Co.....	28	3	23	Taylor 44	Ventura

## SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

## ORE BUYERS LICENSE ACT,

commonly referred to as

### "THE HIGH GRADE BILL"

Chapter 70, Statutes 1925; Amended 1927; Amended 1929  
(Chapter 183)

An act to provide for the regulation, control and licensing of any person, firm or corporation, engaged in the business of milling, sampling, concentrating, reducing, refining, purchasing or receiving for sale ores, concentrates, or amalgams, bearing gold or silver, gold dust, silver or gold bullion, nuggets or specimens; to provide rules and regulations therefor; and to provide penalties for the violation of the provisions of this act.

SECTION 1. Hereafter it shall be unlawful for any person, firm, association or corporation without first procuring the license herein provided for, to engage in the business of milling, sampling, concentrating, reducing, refining, purchasing or receiving for sale, ores, concentrates, or amalgams bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens. Every person, firm, association, or corporation who annually mills samples, concentrates, reduces, refines, purchases or receives for sale such ores, concentrates or amalgams of the total value of one thousand dollars or more, shall pay a license tax of fifteen dollars per annum to the State of California. Every such person, firm, association or corporation who annually mills, samples, concentrates, reduces, refines or who purchases or receives for sale such ores, gold or silver concentrates or amalgams of the total value of less than one thousand dollars shall pay a license tax of two dollars per annum to the State of California. No license shall be granted to any person, firm or association unless such person and the members of such firm or association shall be bona fide residents of the State of California, and of good moral character; and no license shall be granted to any joint stock company or corporation unless such company or cor-



poration is duly qualified to exist and do business as a corporation of this state or unless such company or corporation has complied with all the laws of this state relating to the qualifications of foreign corporations to do business in this state; *provided*, that this section shall not be construed as requiring a license for any mill, sampler, concentration or reduction plant used exclusively by the owner in sampling, milling, or reducing or concentrating ores produced by such owner.

SEC. 2. The application for license to carry on such business must be made to the state mineralogist of the State of California, and shall contain the full names and addresses of applicants, if natural persons, and in the case of firms and associations the full names and addresses of the members thereof, and in the case of corporations, the full names and addresses of the officers and directors thereof, and the place or places where such business is to be carried on. Such application shall be sworn to by the person making it. Every license granted shall date from the first day of the month in which it is issued and expire on the thirty-first day of the following December, and such license or copies thereof shall be kept conspicuously displayed in the place or places of business of the licensee within the State of California. Every application shall be filed not less than thirty days prior to the granting of such license, and notice of the filing of such application shall be posted in the office of said state mineralogist and be published at the cost of the applicant once a week for three successive weeks in a newspaper published in the county or counties where such business is to be carried on. Protest may be made by any person to the issuing of such license, and when such protests are filed with the state mineralogist, the latter shall give notice of and hold a public hearing upon said protest before issuing such license. The said state mineralogist shall have the power to reject any application or license after a hearing upon such protest as aforesaid, and he shall also have power to revoke any license for failure on the part of the licensee to observe this act or any part thereof, or when the licensee shall have violated the provision or provisions of any law of the State of California relating to ore buying or of any law of said state relating to larceny or receiving stolen property; *provided*, that no license shall be revoked except upon written charges filed by two or more reputable persons as accusers, specifying the violations of law for which revocation is sought, and after a public hearing as in case of protests against the granting of licenses. An application for a review of any order granting, refusing, or revoking, a license made by the state mineralogist under this act, may be made to the superior court in and for the county where the aggrieved parties reside, by any person or persons who may feel aggrieved by such order and whose name or names appear in the record of the proceedings before the state mineralogist as a licensee, applicant for license, protestant, or accuser, by lodging in the office of the clerk of said court a certified copy of the transcript of the proceedings before the state mineralogist, including copies of all papers filed therein. The transcript shall be accompanied by a short petition naming the person or persons applying for the review as plaintiff or plaintiffs and the state mineralogist as defendant, and praying for a review of the order.

Within ten days after lodging such application the party or parties applying for the review shall serve notice of its pendency upon the

state mineralogist, in writing, and if the review be of an order granting a license or refusing to revoke a license, such notice shall also be served upon the person to whom the license was thereby granted or whose license was thereby permitted to remain in force.

Such notice may be served by personal delivery or by registered mail, and proof of service shall be made to the satisfaction of the court if not admitted. No review shall be allowed unless taken within thirty days after entry of the order. The said court shall try all such reviews upon the transcript, and such evidence as may be offered and admitted. When the court has finally determined any such proceeding, it shall forthwith cause its order in the premises to be certified to the state mineralogist. The costs in such review shall be awarded at the discretion of the court, and if any costs are awarded against the state mineralogist, the same shall be paid out of funds arising from the payment of license fees under this act. When a review is had, as herein provided, of an order of the state mineralogist revoking a license, such review shall operate as a stay upon such order.

For the making of the transcript herein provided for, the state mineralogist shall collect from the person or persons ordering the same, twenty-five cents per folio of one hundred words, and twenty-five cents for certifying the same.

The superior court in and for the county or city and county in which the aggrieved party or parties reside shall have the right and jurisdiction to review the action of the state mineralogist in granting, refusing, or revoking a license.

SEC. 3. (Repealed.)

SEC. 4. Every person, firm, association or corporation, carrying on such business, shall keep and preserve a book in which shall be entered at the time of the delivery of any ores, concentrates or amalgams, bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens:

First—The names of the party on whose behalf such ores, concentrates, gold dust, gold or silver bullion, nuggets or specimens are delivered;

Second—The weight, or amount, and a short description of each lot thereof;

Third—The name and location of the mine or claim from which it shall be stated that the same has been mined or procured;

Fourth—The name of the party delivering the same;

Fifth—The date of delivery; and

Sixth—Whether the party making the delivery is a lessee, superintendent, foreman, or workman in such mine.

Such book shall be open for inspection to the state mineralogist, his deputies, officers, and agents, on every day except Sundays and legal holidays, between the hours of nine o'clock in the forenoon and five o'clock in the afternoon. If any person, on his own behalf or being duly authorized thereunto by another, shall make and file with the said state mineralogist an affidavit stating that to his best knowledge and belief he or his principals, as the case may be, has, within the three months next preceding the filing of such affidavit, sustained a loss of any of the above described property, by theft or trespass, and that he believes that such property was delivered to a licensee under



this act, naming such licensee, the state mineralogist shall forthwith issue a permit to such person to examine the book kept by such licensee under this act; and upon the presentation of such permit to such licensee, such person shall have the right to inspect and examine the entries made in said book during said period of three months, on the same terms and conditions as the state mineralogist.

SEC. 4a. The state mineralogist shall prescribe the form and contents of all reports in order to comply with section 4 of this act and it shall be the duty of every person, firm, association or corporation to file monthly with the state mineralogist a report of all purchases made under the provisions of this act. Any licensee who shall fail or refuse to comply with the provisions of this act shall be deemed guilty of a misdemeanor.

SEC. 4b. All officers and employees empowered by law or authorized by a superior to enforce the provisions of this act are hereby vested with the powers of peace officers to enforce the provisions hereof and may seize and hold any ores, concentrates, or amalgams bearing gold or silver, gold dust, gold or silver bullion, nuggets or specimens wherever found and whenever there appears to be reasonable grounds to believe such ores, concentrates or amalgams have been stolen or otherwise illegally taken, and to hold the same for use as evidence in any action which may be brought.

Whenever any such ores, concentrates or amalgams so seized and held appear to be no longer of use as evidence, the same shall be delivered to the owner thereof upon proof of such ownership, and any person, firm, association or corporation claiming ownership may file a petition in the superior court of the county of his or its residence showing his or its claim or right thereto. A copy of said petition must be served on the attorney general at least twenty days before the hearing thereof who must answer the same and upon the hearing of said petition the court must try the issue as issues are tried in civil actions and if it determines that the petitioner is entitled to such ores, concentrates or amalgams, the court must order the same delivered to such petitioner. If such ores, concentrates or amalgams be not so delivered to the owner thereof as aforesaid, the same shall, after a period of five years from the date upon which the same was so seized and held, escheat to the state upon action brought by the attorney general in the superior court of the State of California in and for the county of Sacramento, in which action shall be joined as parties defendant all persons claiming to be owner or having any right or interest therein. Service of process in such action shall be made as summons is served in other civil actions upon any known claimant and by publication thereof at least once a week for three successive weeks in a newspaper of general circulation printed and published in the county of Sacramento before the trial of such action. Upon the trial the court must hear all parties who have appeared therein and if any such party shall prove his or its ownership or that he or it has any right or interest therein, the court shall make an order for the delivery thereof to such person, firm, association or corporation, or the sale thereof and a distribution of the proceeds to discharge the right or interest which any such person, firm, association or corporation may prove to have therein, or declare such ores, concentrates or amalgams or the balance of the proceeds of the sale thereof to have escheated to the state. Thereafter the state mineralogist may



sell such ores, concentrates and amalgams not theretofore sold by court order and account for and report the proceeds of such sales to the state controller and at the same time said moneys shall be remitted to the state treasury to be credited to the ore buyer's license fund hereinafter in this act created.

SEC. 5. Any licensee under this act who shall fail, or neglect or refuse to keep and preserve the book herein provided for, shall forfeit his license and shall in addition, upon conviction, be liable to the penalties provided in section 8 of this act. Any licensee or other person who shall knowingly make any false entries upon such book, or knowingly enter or cause to be entered upon the same any false or fictitious names, shall upon conviction, be liable to the penalties provided in section 8 of this act. Any licensee who shall refuse to permit any person duly authorized as herein provided to inspect said book or the entries therein, shall, on conviction, be liable to the penalties provided for a violation of this act and shall forfeit his license.

SEC. 6. Any person who shall knowingly make any false statements concerning any of the facts required to be stated in section 4 of this act shall be guilty of a misdemeanor.

SEC. 7. Complaints against any licensee or applicant shall be made in writing to said state mineralogist, and reasonable notice thereof, not less than three days shall be given to said licensee or applicant by serving upon him a copy of such complaint, and a hearing shall be had before the said state mineralogist within one week from the date of the filing of the complaint, and no adjournment shall be taken for longer than one week. A daily calendar shall be kept of all hearings by said state mineralogist, which shall be posted in a conspicuous place in his public office for at least three days before the date of such hearing. The said state mineralogist shall keep a record of all such complaints and hearings, and may refuse to issue and shall suspend or revoke any license for any good cause shown, within the meaning and purpose of this act; and when it is shown that any licensee or applicant under this act, either before or after conviction, is guilty of any conduct in violation of this or any law relating to such business, it shall be the duty of the said state mineralogist of the State of California to suspend, revoke or reject the license of such licensee or applicant, but notice of the proposed action shall be presented to and reasonable opportunity shall be given licensee or applicant to be heard in his defense. Whenever for any reason such license is revoked, said state mineralogist shall not issue another license to said licensee until the expiration of at least one year from the date of revocation of such license. The state mineralogist shall decide all matters submitted to him within thirty days from the time he takes them under advisement.

SEC. 8. Any violation of sections 1, 4, 4a and 5 of this act shall be punishable by a fine of not less than one hundred dollars and not more than one thousand dollars, or by imprisonment in the county jail for not less than thirty days nor more than six months or both such fine and imprisonment. The state mineralogist shall notify the district attorney of the county in which the offense occurs of such violation, and the said district attorney shall institute criminal proceedings for the enforcement of this act before any court of competent jurisdiction. All forfeited bail and fines received under the provisions of this section shall be sent without delay by the magistrate receiving

the same, fifty per cent to the state treasurer, to be deposited in the state treasury to the credit of the ore buyer's license fund hereinafter in this act created and fifty per cent to the city treasurer of the city, if incorporated, or to the county treasurer of the county in which the prosecution is conducted.

SEC. 9. Except as herein otherwise provided, all moneys received by the state mineralogist under the provisions of this act, shall be accounted for and reported monthly by said mineralogist to the state controller to be remitted by said controller to the state treasury to the credit of a fund to be known as "the ore buyer's license fund" which said fund is hereby created; except that moneys deposited with the state mineralogist for fees for licenses which have not been granted shall be retained by the state mineralogist in the trust fund of the division to be remitted to the state treasurer upon the issuance of the license or returned to the applicant in case a license is refused under the provisions of sections 2 and 7 hereof. All moneys placed in said fund under the provisions of this section or sections 3, 4b and 8 of this act, shall be expended, in accordance with law, for the payment of all actual and necessary expenses incurred in carrying out the provisions of this act.

SEC. 10. Nothing in this act contained shall be construed as limiting, affecting or abrogating any provisions of any law now in force or that may hereafter be enacted transferring to and vesting in the department of natural resources all of the duties, powers, purposes, responsibilities and jurisdiction of the state mineralogist or any officer, deputy, agent, assistant or employee as provided in this act.

SEC. 11. If any section, sentence, clause or phrase of this act is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this act. The legislature hereby declares that it would have passed this act and each sentence, clause and phrase thereof, irrespective of the fact that any one or more of the sections, sentences, clauses or phrases be declared unconstitutional.



ASSESSMENT WORK ON MINING CLAIM WITHIN  
WITHDRAWN AREAS

By A. H. RICKETTS, of the San Francisco Bar.

A recent decision of the Court of Appeals of the District of Columbia is of vital significance to the miner, as it deals with the very important phase of assessment work on valid mining claims within areas which have been subsequently withdrawn from mineral locations. The case of *United States ex rel. Krushnic vs. West, Secretary of the Interior*<sup>1</sup> involved four main points which are summarized in the syllabus, as follows, to wit:

"1. Mines and minerals—Locator, resuming assessment work before relocation, was entitled to patent, notwithstanding law withdrawing certain mineral deposits from private acquisition (30 U. S. C. A. §§ 28, 92; Leasing Act, § 37 [30 U. S. C. A. § 193]).

"Under Mining Law (Rev. St. §§ 2324, 2325; 30 U. S. C. A. §§ 28, 29), locator of mining claim, resuming assessment work before intervention of relocation, was entitled to a patent, notwithstanding Leasing Act, § 37 (30 U. S. C. A. § 193), withdrawing certain mineral deposits from private acquisition, since locator was not by reason thereof subjected to any forfeitures that did not apply to Mining Act, and mere fact that oil shale claims were no longer subject to relocation did not affect rights of original locator under existing laws.

"2. Mines and minerals—Rights of locator can be terminated only by relocation of claim by adverse party (30 U. S. C. A. §§ 28, 29).

"Statutory requirements of Rev. St. §§ 2324, 2325 (30 U. S. C. A. §§ 28, 29), as to annual expenditure on an unpatented mining claim, is not matter of concern to the Interior Department, and rights of locator can not be terminated, except by relocation of claim by adverse party after failure to do assessment work.

"3. Mandamus—Secretary of the interior may be compelled by mandamus to issue patent for mining claim.

"Secretary of the Interior may be compelled by writ of mandamus to issue patent to locator of mining claim, where nothing remains to be done by the secretary but the performance of the mere ministerial act of issuing the patent, notwithstanding that secretary had misinterpreted statutory duty in conformity with the facts.

"4. Mines and minerals—One complying with all requisites entitling him to patent is to be regarded as equitable owner.

"A person who complies with all the requisites necessary to entitle him to a patent for a particular lot or tract is to be regarded as equitable owner thereof."

The points involved and the reasoning of the court are considered of sufficient importance to quote the opinion in full, herewith:

"Van Orsdel, Associate Justice. Appellant, hereafter referred to as plaintiff, filed his petition for a writ of mandamus against the

<sup>1</sup> 30 Fed. (2nd.) 742. Argued Dec. 5, 1928: Decided Jan. 7, 1929.



Secretary of the Interior to compel the issuance to him of a patent on certain oil shale mining land in Garfield County, Colorado. On his response to the rule to show cause, the court, on hearing, discharged him and dismissed the petition.

"From the facts set forth in the petition, and admitted by the response to the rule, it appears that plaintiff and seven associates, on October 1, 1919, located, together with a number of other claims, the mining claim here in question, known as Spad No. 3, placer claim, which was at that time subject to appropriation under the mining laws of the United States. An attempt was made by plaintiff and his associates to perform the actual labor required on the claim for the year 1920. The labor performed was on contiguous claims, and not on the claim in question, which led to a dispute as to the sufficiency of the performance of the assessment work for the year 1920. Thereafter plaintiff acquired the interest of his colocators and performed the labor required for the assessment year 1921, and continued to perform annual labor until the improvements on the claim were of a value more than \$500, when he applied for a patent on December 16, 1922.

"It further appears that at no time after the date of the original location of the claim was any attempt at relocation thereof made by any other person, and no contest has been instituted by any one to question plaintiff's ownership of the claim. However, after the application for patent was made, contest proceedings were instituted by officers of the Department of the Interior. On hearing, all the charges made by the government against the claim were either withdrawn or dismissed by the register, except the charge as to the insufficiency of the annual labor for the assessment year 1920. On this ground alone the Commissioner of the General Land Office held the claim to be null and void, and this holding was approved by the Secretary of the Interior.

"Plaintiff then filed his petition in the Supreme Court of the District of Columbia for a writ of mandamus, and from the order of the court dismissing the petition this appeal was taken.

"It is conceded by counsel for the Secretary that, but for the intervention of the Leasing Act of February 25, 1920, 41 Stat. 437, during the time when this claim was subject to relocation, plaintiff, under the mining law in force prior to the passage of the Leasing Act, would be entitled to his patent. The pertinent provisions of the Mining Law applicable to this case was found in sections 2324 and 2325, Rev. Stats. U. S. (30 U. S. C. A. §§ 28, 29). Section 2324 provides in part as follows:

"On each claim located after the tenth day of May, eighteen hundred and seventy-two, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year. \* \* \* And upon a failure to comply with these conditions, the claim or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, *provided that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location.*" (Italics supplied.)

"Section 2325 provides the procedure for obtaining a patent, and, among other things, 'that five hundred dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors.'"

"We come now to consider the effect on plaintiff's rights by reason of the intervention of the Leasing Act during the period, 1920, when, it is asserted, the claim was subject to relocation under the Mining Law. Section 37 of the act (30 U. S. C. A. § 193) provides as follows:

"That the deposits of coal, phosphate, sodium, oil, oil shale, and gas, herein referred to, in lands valuable for such minerals, including lands and deposits described in the joint resolution entitled 'Joint Resolution Authorizing the Secretary of the Interior to Permit the Continuation of Coal-Mining Operations on Certain Lands in Wyoming,' approved August 1, 1912 (Thirty-seventh Statutes at Large, page 1346), shall be subject to disposition only in the form and manner provided in this act, except as to valid claims existent at date of the passage of this act and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws, including discovery.'

"The Secretary of the Interior, in his opinion refusing to issue plaintiff a patent, recognized the well-established principle under the Mining Law of 1872, to the effect that a failure to perform the assessment work as provided in the act subjected the claim to relocation, and, if it is so located before the original claimant resumes work, his rights are lost. But if no relocation is made, and the original claimant resumes work, his rights stand the same as if there had been no failure to comply with the conditions of the act subjecting the claim to relocation.

"In his opinion, however, as to the effect of section 37 of the Leasing Act, he said:

"There is no doubt that the doctrine above quoted continues to be the law as to mineral lands that continue to be subject to location and purchase under the general mining law, but it is not the law as to mineral lands affected by the Leasing Act. Section 37 thereof at one blow destroyed the right of relocation of such minerals and with it fell the right of resumption. It is contrary to the declared purpose and object of the act to assume that, in doing away with the system of a free grant of the minerals and the grant of a fee title, it was intended to preserve all the rights of a mining locator and at the same time relieve him of his duties, for that is the consequence if neither the government nor an individual can now take advantage of his default. The fair and obvious meaning of section 37 is that, if the annual work is not done, all the rights of the claimant are gone.'

"[1] We think that the Secretary is in error in his construction of the Leasing Act. In section 37 of the act, *supra*, congress excepted from the provisions of the act valid claims existing at the date of its passage "and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws, including discovery." It will be observed that this provision merely circumscribes the operation of the Mining Act in respect of certain mineral deposits lying within the public domain and subject to discovery and location under that act. By the Leasing Act these mineral deposits, including oil shale, are withdrawn from private acquisition, except as to valid existing claims at the date of the passage of the Leasing Act. There is no apparent intention on the part of congress, by the provisions of the Leasing Act, to include within its terms claims initiated under the Mining Law, and which had a valid existence at the date of its passage. Inasmuch as it is conceded in this case that, but for the passage of the Leasing Act, plaintiff's claim is valid and entitles him to a patent, it must be conceded that its validity, in the absence of any intervening relocater, continued at all times from the date of location until the filing of his application for a patent. We interpret the exception to mean that so long as a person, who located a claim prior to the passage of the Leasing Act, maintains and observes the requirements of the Mining Act, and on complete compliance



therewith applies for his patent, he comes within the exception to the Leasing Act and is not barred thereby. Such a locator is not subjected to any forfeitures that did not apply to the Mining Act, and the mere fact that oil shale claims were no longer subject to relocation after the passage of the Leasing Act is of no importance. Until relocation intervened, the claim of the original locator, or his lawful successor in interest, remained unimpaired. His rights after resumption were restored to exactly the same standing that they had, if no default had been made.

"[2] The statutory requirement of the Mining Law of annual expenditure upon an unpatented mining claim never was considered, either by the courts or the government, as a matter of concern to the Interior Department. Section 53 of the Department Regulations, adopted after the passage of the Mining Act, declares that

"The annual expenditure of \$100 in labor or improvements on a mining claim, required by section 2324 of the Revised Statutes, is solely a matter between rival or adverse claimants to the same mineral land and goes only to the right of possession, the determination of which is committed exclusively to the courts."

"This rule has been followed in the courts generally, and in the federal courts it has been held that mere failure to perform the required annual labor does not, in the absence of the intervention of a relocater, work a forfeiture. In *Bingham Amalgamated Copper Co. vs. Ute Copper Co.* (C. C.) 181 F. 748, the court said:

"The contention is also made that, because the plaintiff failed to affirmatively show the performance of assessment work for its claim for the year 1906, it must be denied relief. A failure to perform the required annual labor does not in and of itself work a forfeiture. It only permits a relocation. As the Abraham claim was located February 25, 1906, it can not be considered a relocation of the plaintiff's claims, based on the failure to perform the annual labor for 1908."

To the same effect are *North Noonday Mining Co. vs. Orient Mining Co.* (C. C.) 1 F. 522; *Thatcher vs. Brown* (C. C. A) 190 F. 708.

*Belk vs. Meagher*, 104 U. S. 279, 26 L. Ed. 735, was a suit in ejectment between an original locator of a mining claim and a relocater. In that case the rule is clearly announced that mere failure to do assessment work does not terminate the locator's right of possession, until there has been an interruption by the intervention of a relocater. On this point the court said:

"It seems to us clear that, if work is renewed on a claim after it has once been open to relocation, but before a relocation is actually made, the rights of the original owners stand as they would if there had been no failure to comply with this condition of the act. (Italics supplied.) The argument on the part of the plaintiff in error is that, if no work is done before January, 1875, all rights under the original claim are gone; but that is not, in our opinion, the fair meaning of the language which Congress has employed to express its will. As we think, the exclusive possessory rights of the original locator and his assigns were continued, without any work at all, until January 1, 1875, and afterwards if, before another entered on his possession and relocated the claim, he resumed work to the extent required by the law. His rights after resumption were precisely what they would have been if no default had occurred."

"In *Forbes vs. Gracey*, 94 U. S. 762, 24 L. Ed. 313, it was held that, while the title to mineral lands remains in the United States until a patent issues therefor, the ores dug and detached from the lands under a mining claim are free from any lien, claim, or title of the United States. They are the personal property of the miner, and as such subject to state taxation. It was also held that a mining claim is property in the fullest sense of the word, and that the claim of the



locator is subject to a lien for state taxes and may be sold for the non-payment of them without infringing in any respect the paramount title of the United States in the land. This, it will be observed, is clear authority for the proposition that the government has no responsibility or interest in the contests between rival claimants, or in the case when detached from the land.

"The rule that mere failure to perform annual assessment work does not constitute in itself a forfeiture has been upheld by the court of the mining states of the West. In *Field vs. Tanner*, 32 Colo. 278, 75 P. 916, the Supreme Court of Colorado said:

"It will be observed that failure to do the annual assessment work does not ipso facto, work a forfeiture of a lode mining claim, but the same merely become liable to forfeiture, which may be complete and final when the rights of the third persons accrue. If, however, before such rights do attach, the original locator resumes work, the forfeiture is avoided. *McGinnis et al. vs. Egbert*, 8 Colo. 4 (5 P. 652); *Belk vs. Meagher*, 104 U. S. 279 (26 L. Ed. 735)."

To the same effect are *Lacey vs. Woodward*, 5 N. M. 583, 25 P. 785; *Emerson et al. vs. McWhirter et al.*, 133 Cal. 1036, 65 P. 510; *Madison et al. vs. Octave Oil Co.*, 154 Cal. 768, 99 P. 176; *Florence-Rae Coppe Co. vs. Kimbel*, 85 Wash. 162, 147 P. 881.

"It would require a stretch of the imagination to hold that under this existing policy it was intended by congress that the government through its Secretary of the Interior, might assume the functions of a relocater and enforce the forfeiture of the locator and dispossess him of his claim. (Italics supplied.) The Secretary, however, bases his opinion upon the recent case of *Hodgson vs. Midwest Oil Co.* (C. C. A. 17 F. (2d) 71. That case, we think, has little if any bearing upon the question here in issue. It turned largely upon a question of pleading. It appears that the original locator located the oil claim in question in Carbon County, Wyoming, in 1887, and alleged in his petition for ejectment that he had been in open, notorious, continuous, exclusive and adverse possession of the claim from the date of discovery, May 2, 1887, down to April 22, 1921, and that more than \$500 worth of labor had been expended in improvements thereon prior to September 27, 1909, when by an executive order of the President of the United States all vacant and unappropriated public lands and petroleum deposits in the public domain were withdrawn from location and entry under the mineral public land laws. He further alleged that on May 10, 1910, William C. Henshaw and seven others secretly, fraudulently, clandestinely, and unlawfully, entered upon said mining claim and made a location thereof; and that on August 19, 1920, the defendants filed an application for an oil and gas lease on the said land which was thereafter granted, and that on or about April 22, 1921, the defendants wrongfully and unlawfully entered into the actual, exclusive, and adverse possession of said lands, ousting plaintiff's predecessors therefrom, and have since wrongfully and unlawfully held possession of the same.

"The question of pleading on which the case turned was the sufficiency of the averment that plaintiff was ousted from possession by the defendants in 1921. The court, after quoting from *Lindley Oil Mines* (3d Ed.) § 634, to the effect that a locator can not be deprived of his inchoate rights by the tortious acts of others, said:

"Now in the instant case there is no plea of any threat of violence or physical opposition whatever. There is no allegation in the petition that the plaintiff or his predecessors, or any of them, ever offered or attempted to do assessment work during the period named (the year 1921). The formal plea of entry and actual, exclusive and adverse possession of a quarter section of land constituting a placer mining claim located after discovery, would not seem to be equivalent to an allegation of such hostile acts and declarations as to satisfy a man of ordinary prudence that it would be unsafe to begin work."

"The court accordingly held that in the absence of any showing of assessment work done for the year 1921 all possessory rights of the plaintiff terminated. In reaching this conclusion, the court said:

"It is clear that, such original locator and his assigns (were) required as a condition subsequent to do the so-called 'assessment work' periodically, and, upon failure so to do during any interval fixed by law, all possessory rights terminated. Ordinarily, and in the absence of any withdrawal, the locator would have the right to relocate, equally only, however, to any other person qualified to locate. \* \* \* It is well settled that a failure to do the work or have an adequate legal excuse automatically terminates the locator's right of possession."

"These declarations seem to be in conflict with the settled mining law of more than 50 years. We are unable to find an authority, either judicial or departmental or of a text-writer, where it has been held that a relocation of the claim is essential before resumption of work by a delinquent locator. 'Resumption of work at any time prior to the lawful inception of an intervening right prevents forfeiture. It does not restore a lost estate.' 2 Lindley, Mines (2d Ed.) § 851. Quoted with approval in *Knutson vs. Fredlund*, 56 Wash. 634, 106 P. 202. The locator neither loses his title in his claim nor automatically terminates his right of possession by mere failure to do his assessment work within the statutory period. These rights can only be affected by the relocation of the claim by an adverse party.

"It will also be observed that the opinion was not grounded upon the effect of the intervention of the Leasing Act, further than to hold that by the failure of the plaintiff to perform his assessment work in the year 1921 his rights were lost, and the claim became subject to disposition under the existing law which at that date was the Leasing Act. It involved no construction of the Leasing Act to the effect that the Secretary of the Interior may assume the status of a relocater or that the exception in the Leasing Act applied to a case of this sort. The fundamental error in the opinion, as we have pointed out, was in holding that failure to do assessment work automatically terminates a locator's rights. It was this misinterpretation of the law which led the department into error.

"We construe the exception in the Leasing Act as intended to preserve all the rights of the locator of an existing claim at the time of its passage. It is urged, however, by counsel for the Secretary that if the Leasing Act only prohibits the relocation by the third party of an existing mining claim, the original locator may defer his assessment work indefinitely, or at least so long as he may evade the charge of abandonment. It is difficult to conceive just how the disqualification of the relocater can affect rights accorded the locator by the statute. The locator, by virtue of his location and development of the mine, acquires a valuable property right that may never develop into a patent.

"In the Forbes case these claims are described as

"Property in the miner, and property of great value. \* \* \* They are property in the fullest sense of the word, and their ownership, transfer, and use are



governed by a well-defined code or codes of law, and are recognized by the state and the federal government. This claim may be sold, transferred, mortgaged, and inherited, without infringing the title of the United States.'

"Neither is this a matter of serious concern to the government, since these rights were conferred in aid of a policy to insure the development of the mining industry. No intention was displayed by congress of returning any revenues to the government from the minerals extracted either before or after patent of the lands. The only possible benefit that accrued to the United States was through the sale of the land for a nominal consideration. It, therefore, was a matter of little concern where the paramount title to the land remained. In either instance, the government was neither a gainer nor a loser. Indeed by the failure of the locator to purchase, the government retained title in the land and stood to be a gainer through failure of the locator to protect his rights.

*"A part of the property right vested in the locator was to resume delinquent assessment work without penalty for his delinquency, and until this right had been foreclosed by the relocation of the mine by a third party it remained a valuable incident of the grant. It logically follows that if congress in the Leasing Act had intended to deprive a prior locator of this valuable privilege, it would have given expression to that intent in clear and unmistakable language. Not only is the act silent in this particular, but there is nothing in the language of the exception on which to hang such a judicial inference. It clearly excepts existing claims that continue to be MAINTAINED in conformity with the mining law under which the locator's right had its inception. There is clearly no intent manifested of subjecting this valuable privilege to confiscation by operation of departmental law (Italics supplied.)"*

"[3] We come now to the usual objection presented by the department, namely, the jurisdiction of the court to compel the Secretary by writ of mandamus, to issue a patent. In this case the court is not invading the exclusive jurisdiction of the Secretary to determine discretionary questions of fact, nor his interpretation of the meaning of a law upon which the exercise of his discretion depends. In the present case, with the facts conceded, nothing remains to be done by the Secretary but the performance of the mere ministerial act of issuing a patent; and if, as in the present case, the Secretary misinterprets his statutory duties in conformity with the facts, it is well within the power of the court to place its interpretation upon the law and direct the Secretary to act in accordance therewith. Perhaps the power of the court, in cases of this character, to control the acts of an executive officer by mandamus, is best expressed in *Roberts vs. United States* 176 U. S. 221, 20 S. Ct. 376, 44 L. Ed. 443, where the court, speaking through Mr. Justice Peckham said:

"Unless the writ of mandamus is to become practically valueless, and is to be refused, even where a public officer is commanded to do a particular act by virtue of a particular statute, this writ should be granted. Every statute to some extent requires construction by the public officer whose duties may be defined therein. Such officer must read the law, and he must therefore, in a certain sense, construe it, in order to form a judgment from its language what duty he is directed by the statute to perform. But that does not necessarily and in all cases make the duty of the officer anything other than a purely ministerial one. If the law direct him to perform an act in regard to which no discretion is committed to him, and which upon the facts existing, he is bound to perform, then that act is ministerial, although



depending upon a statute which requires, in some degree, a construction of its language by the officer. Unless this be so, the value of the writ is very greatly impaired. Every executive officer whose duty is plainly devolved upon him by statute might refuse to perform it, and when his refusal is brought before the court he might successfully plead that the performance of the duty involved the construction of a statute by him, and therefore it was not ministerial, and the court would on that account be powerless to give relief. Such a limitation of the powers of the court, we think, would be most unfortunate, as it would relieve from judicial supervision all executive officers in the performance of their duties, whenever they should plead that the duty required of them arose upon the construction of a statute, no matter how plain its language, nor how plainly they violated their duty in refusing to perform the act required.<sup>7</sup>

"Coming to the more concrete application of the foregoing rule to the present case, the court, in *Ballinger vs. United States ex rel. Frost*, 216 U. S. 240, 30 S. Ct. 338, 54 L. Ed. 464, sustaining an application for a writ of mandamus to compel the Secretary of the Interior to deliver a patent to certain Indian lands, quoted from leading decisions as follows:

"The execution and delivery of the patent after the right to it is complete are the mere ministerial acts of the officer charged with that duty." *Barney vs. Dolph*, 97 U. S. 652, 656, 24 L. Ed. 1063.

"Where the right to a patent has once become vested in a purchaser of public lands, it is equivalent, so far as the government is concerned, to a patent actually issued. The execution and delivery of the patent after the right to it has become complete are the mere ministerial acts of the officers charged with that duty." *Simmons vs. Wagner*, 101 U. S. 260, 261, 25 L. Ed. 910.

"No further authority to consider the patentee's case remains in the land office. No right to consider whether he ought in equity, or on new information, to have the title or receive the patent. There remains the duty, simply ministerial, to deliver the patent to the owner, a duty which, within all the definitions, can be enforced by the writ of mandamus." *United States vs. Schurz*, 102 U. S. 373, 403, 26 L. Ed. 167. To the same effect are *Lane vs. Hoglund*, 244 U. S. 174, 37 S. Ct. 558, 61 L. Ed. 1066; *Work vs. United States ex rel. McAlester-Edwards Company*, 262 U. S. 200, 43 S. Ct. 580, 67 L. Ed. 949.

"[4] In the present case it is conceded that but for the intervention of the Leasing Act appellant would be entitled, under the law, to his patent. In this situation, clearly nothing remains for the Secretary, but to comply with the law and issue the patent; and this may be compelled by a writ of mandamus. "The rule applicable in such a situation is that 'a person who complies with all the requisites necessary to entitle him to a patent for a particular lot or tract is to be regarded as the equitable owner thereof.' " *Payne vs. Central Pacific Railway Co.*, 255 U. S. 228, 237, 41 S. Ct. 314, 316 (65 L. Ed. 598).

"The judgment is reversed with costs, and the cause is remanded for further proceedings not inconsistent with this opinion."

NOTE.—A writ of certiorari has been granted by the United States Supreme Court in the above case.

The doctrine of the above entitled case finds support in the decision of the U. S. Supreme Court in the case of *Work vs. Braffet*, 276 U. S. 560, which involved certain school lands granted to the state of Utah as nonmineral land. Braffet sought to secure title thereto as coal land. The court held that such procedure gave him the status of a contestant endeavoring to overcome the presumptive title of the state upon the ground that the mineral character of the land was known before the school grant attached. This amounted to no more than a privilege of seeking to restore the land applied for to the public domain; and success in the contest would have brought the contestant a preferential right of entry, there being no statute nor regulation securing him such a preference. Such privilege was subject to withdrawal by the United States pending the contest, and was withdrawn by the act of

February 25, 1920 (41 Stats. 437), which provides that coal lands shall be disposed of only by lease, excepting only (§ 37), "valid claims existent at the date of the passage of this act and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws," etc.

The court said:

*"The reference in § 37 to valid claims 'thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws including discovery' at least suggests that they embrace only such substantial claims as would on compliance with the provisions of the former law ripen into ownership; such claims as might be acquired under the mining laws by location possession and development which, if continued to discovery and entry, would entitle the claimant to a patent. That such was the purpose is established by the congressional debates. 58 Con. Rec. pt. 5, pp. 4577-4585. 66th Cong. 1st Sess." (Italics supplied.)*



## SURFACE RIGHTS OF A MINERAL LOCATOR WITHIN THE NATIONAL FORESTS

By A. H. RICKETTS, of the San Francisco Bar.

The exclusive right and title of a valid mineral locator within a National Forest to all of the surface of his claim including the timber growing thereon is affirmed by a decision<sup>1</sup> rendered in the District Court, District of Idaho, N. D., under date of February 11, 1928. The first five points outlined in the syllabus concern the jurisdiction of the federal court and the inhibition against suing the United States; but items 6-11, inclusive, are of particular importance to the mineral locator making and maintaining valid claims within a National Forest, viz:

"6. Mines and minerals—Locator of mining claim on public lands has property in specified amount of surface thereof (30 U. S. C. A. § 26).

"Under 30 U. S. C. A. § 26, relative to rights of locator of mining claim on public lands, specified amount of surface is as much the property of locator as vein or lode discovered and located by him.

"7. Mines and minerals—Locator's possessory title to surface of mining claim on public lands is good against United States (30 U. S. C. A. § 26).

"Possessory title to specified amount of surface in locator of mining claim on public lands, pursuant to 30 U. S. C. A. § 26, is a valuable property right, and good against United States, as well as the world, as long as locator complies with the law.

"8. Mines and minerals—Rights of locators of mining claims on public lands initiated in good faith will be protected as to use of timber in development (30 U. S. C. A. § 26).

"Where locators of mining claims on public lands under 30 U. S. C. A. § 26, have initiated claims in good faith and complied with spirit of law, their rights will be protected, not only to extract ore from claims, but also to use of timber growing thereon in development, against any act or attempt on part of United States to deprive them of such use of timber.

"9. Mines and minerals—Locator's rights to surface of mining claim located on public lands are not qualified by inclusion of claims in forest reserve (30 U. S. C. A. § 26).

"Rights of enjoyment of locator of mining claim on public lands, under 30 U. S. C. A. § 26, including surface of his claim, are not qualified, nor can they be infringed on by including claims in forest reserve.

"10. Mines and minerals—General mining laws apply to mining claims located within forest reserves (National Forest Act, § 1 [16 U. S. C. A. § 482]).

"General mining laws of United States apply to mining claims located within forest reserves, in view of section 1 of act creating

<sup>1</sup> *United States vs. Deasy et al.*, 24 Fed. (2d), 108.



national forest (16 U. S. C. A. § 482), to effect that mineral lands therein shall continue to be subject to location and entry, notwithstanding any provision of National Forest Act.

"11. Mines and minerals—United States may not enjoin locators of mining claims on public lands from interfering with other's removal of timber needed in development (30 U. S. C. A. § 26).

"Where locators of mining claims on public lands pursuant to 30 U. S. C. A. § 26, initiated location claims in good faith, United States was not entitled to enjoin them from interfering with removal of timber necessary to proper development.

The text of the opinion in full follows, to wit:

"Cavanah, District Judge. In this case the United States seeks to enjoin the defendants during the pendency of this action, from interfering with the Jack Waite Mining Company in carrying out the terms of a certain timber sale contract, by which the company agreed to purchase and pay the sum of \$250 to the United States for approximately 500,000 feet of timber, to be cut and removed from certain mining claims located and possessed by the defendants, and situated in the Coeur d'Alene National Forest in Idaho.

"It seems that in the month of August, 1927, the company was engaged in cutting timber from the mining claims under the contract, and while doing so it was stopped and ejected therefrom by the defendants. Shortly thereafter the defendants instituted an action in the state court against the company, which action is still pending, and in which a temporary injunction was issued, restraining it from further cutting of the timber. The assertion is further made in the bill that the location and possession of the defendants of the mining claims are invalid, and that, in the event the company is prevented from cutting the timber, the United States will not receive the sale purchase price therefrom.

"In the answer of the defendants, which is supported by several affidavits, it appears that the mining claims were located, possessed, and being developed and mined according to the mining laws of the United States; that there is estimated to be upon the claims about 750,000 feet of timber, of which the company has already cut one-fifth thereof. The character of the timber is hemlock and spruce, which is useful only for mining purposes and if removed from the claims, the defendants will be left without any timber to carry on their mining operations. A considerable amount of development work has been done by the defendants in the construction of tunnels, which has and will in the future require a large amount of the timber. In the early part of 1927 the company conceived the idea that it wanted the timber in question, located upon the Nora and Dora claims of the defendants, and in June made preparation for the cutting and removal thereof to its mines, situated some distance therefrom. Its conduct in that regard resulted in the bringing of the action in the state court by the defendants, restraining the company from further removing the timber, and there it has answered and presented the same issues involved herein, and also as to whether or not the mining claims of the defendants are in fact valid, and by cross-complaint ask for damages.

"[1-5] \* \* \*

"No claim is made in the instant case that the timber involved is being wasted or destroyed by the defendants, or that the defendants have violated any regulation prescribed by the Secretary of Agriculture relating to the occupation of forest lands, or that the claims are being used for any unlawful purpose. The only contention of the government is that the Secretary has a right to sell and dispose of the timber in the national forests, and that, although the defendants may have a valid lode mining location, yet they have no exclusive right to the timber growing thereon.

"[6] This brings us to a consideration of the principal question involved, as to what are the rights of the locator of a mining claim upon public lands, and we must turn to section 2322 of the Revised Statutes of the United States (U. S. Comp. Stats. § 4618, p. 5466 [30 U. S. C. A. § 26]) to determine it. It is there declared that the locators "shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes, and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically," etc. This right has been extended to the use of sufficient timber upon the claim for development purposes, and includes the use of timber for fuel and what is necessary for shafts, tunnels, and the construction of buildings as may be necessary as an adjunct to such development. The purpose of congress in enacting this statute was to secure the fullest working of the mines and complete development of the mineral property, by securing to the locator the undisturbed possession of not less than a specified amount of surface, *and this surface is as much the property of the locator as the vein or lode discovered and located by him.* (Italics supplied.) *Clipper Mining Co. vs. Eli Mining & Land Co.*, 194 U. S. 220, 24 S. Ct. 632, 48 L. Ed. 944; *Jones et al. vs. Wild Goose Mining & Trading Co. et al.* (C. C. A.) 177 F. 95, 97, 29 L. R. A. (N. S.) 392.

"[7-9] It is true that the locator has only a possessory title, but it is just the same a valuable property right, and as long as he complies with the law it is good against the United States as well as the world. *Belk vs. Meagher*, 104 U. S. 279, 284, 26 L. Ed. 735; *Manuel vs. Wulff*, 152 U. S. 505, 510, 14 S. Ct. 651, 38 L. Ed. 532; *Noyes vs. Mantle*, 127 U. S. 348, 351, 8 S. Ct. 1132, 32 L. Ed. 168. And when it appears, as it does here, that the locators of these claims have initiated them in good faith, and have complied with the spirit of the law, their rights will be protected, not only to extract ore from the claims, *but also to the use of the timber growing thereon in the development thereof, against any act or attempt on the part of the United States to deprive them of such use of the timber.* (Italics supplied.) In the well-considered opinions in *Teller vs. United States* (C. C. A.) 113 F. 273, and *United States vs. Rizzinelli et al.* (D. C.) 182 F. 675, the conclusion is reached that the rights of a locator of a mining claim within the boundaries of a forest reserve are substantially those of one who locates such claim upon the public domain, and gives the locator the right of "exclusive possession and enjoyment of all the surface of their locations." His rights of enjoyment, including the surface of his claim, are not qualified, nor can they be infringed upon by including the claims in a forest reserve.



“[10] The general mining laws of the United States apply to mining claims located within the forest reserves, as the act creating the national forests declares (section 1 [16 U. S. C. A. § 482]) that any mineral lands therein which have been or which may be shown to be such, and subject to entry under the existing mining laws of the United States, shall continue to be subject to such location and entry, notwithstanding any provision of the National Forest Act.

“[11] Having reached the conclusion that the defendants have initiated in good faith their location of these claims, and are complying with the law in possessing and operating the same, and have exclusive right to the use of the timber in question for mining purposes, we then find from the undisputed affidavits presented by the defendants that all of the 750,000 feet of timber growing upon the claims will be needed in their development, and that one-fifth of that amount has already been cut and removed by the defendants. If the Secretary of Agriculture can deprive these locators of two-thirds of the timber upon the contention that they do not need but one-third thereof, he would be granted the power of deciding what amount of timber is necessary to be used in the development of mines, and those engaged in locating and developing mining property would have to secure permission from the Secretary as to the amount of timber they could use upon their claims. The law does not contemplate such a course to be taken.

“Should the court restrain the defendants from cutting and using the 500,000 feet of timber covered by the contract of sale between the United States and the company, and the company is permitted to deprive the locators of the necessary use of it in the development of their claims, then we have a situation of the government first, by statute, granting to the defendants, as locators, the exclusive right to the timber, and thereafter conveying it to another, thus depriving the first locators of their statutory right of use. It would be an idle thing to grant an exclusive right by one act of law, and then take it away by another. This course is not only in violation of their rights granted by the statute, but does not appeal to a court of equity as being just.

“For the reasons stated, the prayer of the plaintiff for a temporary injunction is denied.”

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Within a short time after the above decision had been rendered a bill was introduced in congress, but subsequently killed in committee, to amend the mining law applicable to national forests. The intent of the bill was to deprive the locator of a mining claim to all surface rights covered by the location other than a mere right of occupancy; subject to forest regulations, of so much as might reasonably be necessary to carry on prospecting and mining. A locator would have had no right to take any natural resources, other than mineral deposits or to occupy the ground for any purpose other than mining. Had the bill become a law patents issued under the mining law affecting lands in such forests would carry title only to the mineral deposits within the location, with a reservation to the United States of title to surface of the land therein. Valid mining claims already established as well as those initiated before the bill became a law and within national forests would not have been affected by the act.



## “MINE” AND “MINERAL” DEFINED FOR MINING BUREAU ACT

The Mining Bureau Act (chapter 679, Statutes of 1913) was amended by the recent session of the legislature in two particulars: One, changing the expiration date for mineral producers to send in annual statistical reports, from June 30th to March 31st; two, adding a new section (Sec. 16) defining the terms “mine” and “mineral” for the purposes of the act. The amendment was approved by the Governor, May 14, 1929, and is designated chapter 280, Statutes of 1929. The sections read as follows:

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatsoever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirty-first day of March, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.

SEC. 16. For the purpose of this act and as used herein the term “mine” is hereby defined to embrace and include all mineral bearing properties of whatever kind or character whether underground, quarry, pit, well, spring or other source from which any mineral substance is or may be obtained, and the term “mineral” for the purposes of this act and whenever so used shall embrace and include any and all mineral products both metallic and nonmetallic, solid, liquid or gaseous, and mineral waters of whatever kind or character.



### "DIVISION OF MINES" AMENDMENT

Sections 373*a* and 373*b* of the Political Code, relating to the Department of Natural Resources (chapter 128, Statutes of 1927) was amended at the 1929 legislative session and approved by the Governor, May 18, 1929, becoming effective August 14th. The name of the "Division of Mines and Mining" is changed to "Division of Mines," and a "State Mining Board" is created to consist of five members whose duty will be to determine "general policies for the guidance of the Division of Mines."

The sections as amended follow:

373*a*. For the purposes of administration the department shall be forthwith organized by the director thereof, subject to the approval of the governor, in such manner as he shall deem necessary to properly segregate and conduct the work of the department, and the director shall have power to appoint, in accordance with the civil service and other provisions of law, such deputies, officers and other expert and clerical assistants as may be necessary. The work of the department is hereby divided into at least four divisions to be known as the division of forestry, the division of parks, the division of fish and game and the division of mines.

373*b*. The division of mines shall be administered through a chief who shall be appointed by the director of natural resources upon the nomination of the state mining board, the chief to be a technically trained mining engineer and to be known as the state mineralogist; such chief shall receive a salary of six thousand dollars per annum. General policies for the guidance of the division of mines shall be determined by a board to be known as the state mining board, which shall consist of five members appointed by and to hold office at the pleasure of the governor.



## ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

**Geological Survey.**

A special item of \$20,000 was added to the budget of this Division for the ensuing biennium to provide for the starting of a comprehensive geological survey of California. A beginning on geological survey work in California was made in 1853-1856 under John B. Trask, and in 1860-1872 under James D. Whitney. Since those days considerable of the geology of the state has been studied and worked out, but not coordinated under any comprehensive plan. Various agencies have contributed: U. S. Geological Survey, State Mining Bureau, University of California, Stanford University, California Academy of Sciences, and others.

Twice the State Mining Bureau has published a geological map of the state, 1890 and 1916, in each case compiling in map form the then known data on the areal geology. It is now proposed to follow a comprehensive plan under a probable ten-year program. As the first important item on this program, our newly-appointed chief geologist, Mr. Olaf P. Jenkins is already engaged in cataloguing, coordinating, and evaluating all of the geological work thus far done in California. Field studies are also being conducted in four separate localities, in cooperation with the geological departments of both Stanford University and the University of California by members of the faculty and advanced graduate students.

**Division of Oil and Gas.**

By an executive order signed May 29, 1929, and approved by the Governor on the same date, Mr. Fred G. Stevenot, Director of the Department of Natural Resources announced the transfer of the Department of Petroleum and Gas from the Division of Mines and Mining to the status of a separate division under the Department of Natural Resources—to be known as the 'Division of Oil and Gas.' Mr. Reed D. Bush, State Oil and Gas Supervisor, continues in that position as the chief of the new division. Both divisions will continue to operate side by side and will maintain joint offices as heretofore.

**Division of Mines.**

By an amendment to the Department of Natural Resources Act passed by the recent session of the Legislature and effective August 14, 1929, the name of this division is changed to 'Division of Mines.' An advisory board of five was also created to be known as the State Mining Board, the personnel of which has not yet been appointed.

Amendments were also passed to the Ore and Bullion Buyers Act and the Mining Bureau Act, the details of which are shown elsewhere herein under 'Special Articles.'

**Personnel.**

Mr. Olaf P. Jenkins has been appointed Chief Geologist, and will have immediate supervision of the geological survey activities of this



division. Mr. Jenkins is a graduate of Stanford University, and includes in his several years of experience preparation of the geological maps of Arizona and Tennessee published in cooperation between those states and the U. S. Geological Survey; also assistant state geologist of Washington and geological work in Brazil, Java, Alabama, Oklahoma and California.

Mr. Reid J. Sampson has been appointed assistant district mining engineer and will be associated with Mr. Tucker in the Los Angeles office of this division covering the southern counties. Mr. Sampson is a graduate in mining engineering from Kentucky State University, following which he was engaged some twelve years in the following copper-mining districts: Hancock, Michigan; Cananea, Sonora, Mexico; Arizona. The past ten years have been devoted to examinations and the direction of mine and mill operations in New Mexico, Mexico, and the desert region of California.

Mr. Herbert A. Franke has been appointed a junior mining engineer and assigned to duty as Librarian in the San Francisco headquarters of this division. Mr. Franke is a graduate in geology of the Texas Agricultural and Mechanics College.

Mr. H. V. Dodd has been appointed Deputy Supervisor of District No. 5, effective June 28, in the place of E. H. Musser who has been appointed Deputy Supervisor of District No. 4.

#### New Publications.

During the quarterly period covered by this issue, the following publications of the Division of Mines and Mining have been made available for distribution:

Summary of Operations, California Oil Fields, Vol. 14, Nos. 2, 3, 4, August, September, October, 1928, respectively, containing the following special articles: (August), "Production Statistics"; "Directory of California Oil Operators"; (September), "The Use of Hydraulic Cement in Oil Wells"; (October), "Some Useful Oil Field Tables."

Commercial Mineral Notes, Nos. 73, 74, 75, April, May, June, 1929, respectively. These 'notes' contain the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet, monthly. It is mailed free to those on the mailing list for MINING IN CALIFORNIA.

#### Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

## MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

## STATISTICS

Data on the 1927 production of several California minerals were given in the April issue of MINING IN CALIFORNIA, and some additional ones are presented herein. Copy of the complete annual report for the year is now being prepared and will shortly go to the printer as Bulletin No. 102 of the Division of Mines and Mining.

## COPPER

Copper is second only to gold among the metals mined in California. The output for 1928 amounted to a total of 25,162,304 pounds of recoverable metal valued at \$3,623,360. This was a slight increase in value over the 1927 figures which were 27,350,316 pounds and \$3,582,888. The average price of copper for 1928 was 14.4 cents per pound compared with 13.1 cents a pound in 1927.

As for several years past Plumas County ranks first in the production of copper for 1928 with an output of 21,141,121 pounds. Shasta comes second with 3,049,960 pounds and Trinity third with 660,147 pounds.

Distribution of the 1928 copper output by counties was as follows:

County	Pounds	Value
Amador	1,402	\$202
Calaveras	150,911	21,731
El Dorado	1,074	155
Inyo	22,250	3,104
Madera	14,171	2,031
Plumas	21,141,121	3,044,321
Riverside	13,263	1,910
San Bernardino	106,351	15,314
Shasta	3,049,960	439,194
Trinity	660,147	95,060
Alpine, Butte, Fresno, Imperial, Mariposa, Nevada, Placer, Siskiyou, and Sierra,	1,654	338
Total	25,162,304	\$3,623,360

## GOLD

The production of gold in California in 1928 totaled 521,739.59 fine ounces worth \$10,785,315 being a decrease of 42,845.91 fine ounces from the 1927 yield. The deep or lode mines output accounted for \$5,934,686 and the placers (mainly the dredges) produced \$4,850,629. The Division of Mines has never independently gathered the statistics of gold and silver production and these figures, as in former years, are published by cooperation with and through the courtesy of Mr. V. C. Heikes of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1928 is reported from Yuba County with an output of 111,474.23 fine ounces (\$2,304,377); Amador County second with 108,211.10 fine ounces (\$2,236,922); Nevada County third with 96,459.83 fine ounces (\$1,994,002); Sacramento County fourth

with 75,376.64 fine ounces (\$1,558,173); followed by Sierra and Trinity counties in fifth and sixth places, respectively. With the exception of Amador exceeding Nevada County, the leading gold producer remain in the same order as in 1927. The gold from Yuba and Sacramento comes almost entirely from dredges, while that from Nevada and Amador comes mainly from the lode mines.

Distribution of the 1928 gold output by counties was as follows:

County	Value	County	Value
Alpine -----	\$23	Nevada -----	\$1,994.02
Amador -----	2,236,922	Placer -----	71.95
Butte -----	48,432	Plumas -----	332.63
Calaveras -----	162,372	Riverside -----	2.18
Del Norte -----	277	Sacramento -----	1,558.17
El Dorado -----	122,017	San Bernardino -----	91.71
Fresno -----	15,455	San Diego -----	2.67
Humboldt -----	1,788	San Luis Obispo -----	72
Imperial -----	25	Shasta -----	113.13
Inyo -----	10,781	Sierra -----	674.85
Kern -----	186,453	Siskiyou -----	85.71
Lassen -----	492	Stanislaus -----	195.68
Los Angeles -----	2,187	Trinity -----	402.69
Madera -----	3,580	Tuolumne -----	36.80
Mariposa -----	120,568	Yuba -----	2,304.37
Merced -----	310		
Mono -----	6,307	Total -----	\$10,785.31

#### LEAD

The production of lead in California in 1928 was 1,882,795 pound of recoverable metal valued at \$109,102 as compared with the 1927 figures which were 2,748,440 pounds and \$173,151. The average value of lead in 1928 was 5.8 cents; in 1927 was 6.3 cents; in 1926 was 8.0 cents.

As in the past the principal output of lead was from the lead silver ores of Inyo County.

Distribution of the 1928 lead output by counties was as follows:

County	Pounds	Value
Alpine -----	3,001	\$17
Calaveras -----	2,817	16
Inyo -----	1,733,120	100.42
Riverside -----	99,097	5.74
San Bernardino -----	38,097	2.20
Shasta -----	4,400	25
El Dorado, Los Angeles, Nevada, Plumas, Siskiyou and Tulare -----	2,263	13
Totals -----	1,882,795	\$109.10

#### PLATINUM

In California the platinum group metals are obtained as by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Sacramento, Stanislaus and Shasta counties, with a small amount coming from the hydraulic and surface sluicing mines of Del Norte, Humboldt, Siskiyou, and Trinity counties.

The production of platinum metals in California in 1928 totaled 357 ounces crude containing 312 fine ounces valued at \$27,902 which was an increase over the 1927 figures of 139 fine ounces and \$10,757. Of this amount 306 fine ounces or 98% came from the gold dredges. This metal came from a single producer, in each of the following Calaveras, Sacramento, Shasta, Stanislaus, Trinity, and Yuba counties. Yuba having the largest production. In addition to the above meta



here was some platinum mineral recovered but not sold, in Butte County.

Of the above 312 fine ounces at least 35 fine ounces were iridium, 6 fine ounces osmium, 10 ruthenium and 2 palladium.

Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

#### QUICKSILVER

The production of quicksilver for 1928 in California was 7,107 flasks of 76 pounds avoirdupois) valued at \$844,649. This was an increase both in quantity and value over the 1927 production, which was 6,488 flasks (75 pounds) and \$714,418. This production came from Fresno, Lake, Napa, Orange, San Benito, San Luis Obispo, Santa Clara and Sonoma counties.

During 1928 the average monthly quotations were over \$120 with the highest in September with an average of \$128 for a 76-pound flask. In June, 1927, the price quotations changed from a 75-pound flask to a 6-pound flask.

The average price for quicksilver in 1928 was \$125 for 76-pound flask at San Francisco compared with \$117.25 (76-pound flask) in 1927 and \$87.64 (75-pound flask) in 1926.

Distribution of the 1928 output of quicksilver by counties was as follows:

<i>County</i>	<i>Flasks</i>	<i>Value</i>
Lake -----	1,206	\$145,718
Napa -----	718	85,477
San Benito -----	3,800	452,345
San Luis Obispo -----	435	48,254
Fresno, Orange, Santa Clara, and Sonoma* -----	948	112,855
Totals -----	7,107	\$844,649

\* Combined to conceal output of a single operator in each.

#### SILVER

Except for the early-day production from the silver mines of the Calico district and the more recent production from those of the Randburg area, both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper, lead, and gold ores.

The 1928 silver production of California totaled 1,478,771 fine ounces valued at \$865,081 compared with the 1927 production which was 1,620,242 fine ounces valued at \$918,677. Of the 1928 yield 17,211 fine ounces valued at \$10,068 came from placers. The average price of domestic silver during 1928 was 58.5 cents per fine ounce in New York compared with 1927 at 56.7 cents and 1926 at 62.4 cents.

Distribution of the 1928 silver production by counties was as follows:

<i>County</i>	<i>Fine ounces</i>	<i>Value</i>
Alpine	621	\$30
Amador	24,473	14,31
Butte	1,246	72
Calaveras	2,511	1,40
Del Norte	2	
El Dorado	1,191	6
Fresno	128	
Humboldt	12	
Imperial	2	
Inyo	40,937	23,94
Kern	8,966	5,24
Lassen	14	
Los Angeles	34	
Madera	246	14
Mariposa	3,759	2,10
Merced	3	
Mono	301,052	176,11
Nevada	35,552	20,79
Placer	578	34
Plumas	326,725	191,13
Riverside	2,672	1,50
Sacramento	3,041	1,77
San Bernardino	620,070	362,74
San Diego	22	
San Luis Obispo	2	
Shasta	67,403	39,44
Sierra	6,176	3,60
Siskiyou	719	44
Stanislaus	950	50
Trinity	20,954	12,20
Tuolumne	316	18
Yuba	8,394	4,90
Totals	1,478,771	\$865,08

## MUSEUM

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men and prospectors as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

## LABORATORY

FRANK SANBORN, Mineral Technologist

The pottery clay output in California for the year 1927 was 867,411 tons. In addition to this amount a considerable tonnage of the monmorillonite or bentonite clays was mined.

Bentonites, similar to the material mined in Wyoming, can usually be identified by the action of the clays when placed in water. The material will absorb a great amount of water and swell to large proportions, forming a creamy mass.

Most of the bentonite now mined is used as a decolorizer in the refining of petroleum oils.

In 1926 a United States patent was granted for the use of bentonite, treated with an oil and mixed with concrete, as a waterproofing medium and filler.

There are no simple tests for ceramic clays; a clay may be rejected by one manufacturer, and this same clay may be quite suitable in some other plant.

Simple field tests for making a rough determination of clays were published in the Third Report of the West Virginia Geological Survey. They are as follows:

1. A small lump of clay may be roasted in the flame of a gas stove. If it turns red or brown, the percentage of iron is high, probably more than four per cent.

2. By tasting the clay, bitter salts, such as alum and epsom, may be detected, or such salts may occur as white coatings on the outcrops of the clay in the bank. These salts are apt to form whitewash coats on the finished brick, injuring their appearance. Sand may be detected by grit against the teeth. A rough idea of the percentage of such sand may thus be made.

3. A good idea of its plastic qualities may be obtained by working the moist clay with the fingers. A good test for pottery clay is to thus moisten it, and determine whether it can be worked into a definite shape, and whether or not it will retain its form when dry without cracking.

4. Shrinkage: A rough brick can easily be made and dried, and a good idea of the shrinkage arrived at. If it cracks or crumbles when dry or shrinks out of shape, its value is very doubtful. For this test, however, the clay should be ground thoroughly, tempered with water, and dried slowly.

5. If carbonates of lime are present, a few drops of hydrochloric acid will cause effervescence or bubbling, as the carbonic acid gas passes off. Very high percentages of lime are apt to ruin the clay. Good fire bricks are made of clay low in lime content.

6. The slaking of clays, or the crumbling down in tempering is tested by dropping a lump of clay in a cup of water. Some clays slake in a very few minutes, and so are easily tempered.

7. The color of a finished clay product is largely determined by the amount of iron present. It is not always possible to predict the color of the burned ware from the color of the clay. It is true that red clays will usually burn red, but blue clays or those of other shades also commonly burn red or buff. The color of the raw clay is often due to organic matter which is combustible, and will be consumed in the burning.



## LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines and Mining contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

## OFFICIAL PUBLICATIONS RECEIVED

## Governmental.

U. S. Geological Survey:

## Professional Papers:

- 144 —The Copper Deposits of Michigan. By B. S. Butler and W. S. Burbank.
- 154-B—The Fauna of the Middle Boone Near Batesville, Arkansas. By G. H. Girty.
- 154-C—Salinity of the Water of Chesapeake Bay. By R. C. Wells, R. K. Bailey and E. P. Henderson.
- 154-D—Origin of the Siliceous Mowry Shale of the Black Hills Region. By W. W. Rubey.
- 154-E—Oil Shale in a Producing Oil Field in California. By H. W. Hoots.
- 154-F—Water-Laid Volcanic Rocks of Early Upper Cretaceous Age in Southwestern Arkansas, Southeastern Oklahoma and Northeastern Texas. By C. S. Ross, H. D. Miser and L. W. Stephenson.
- 154-G—Algae Reefs and Oolites of the Green River Formation. By W. H. Bradley.
- 154-H—A Revision of the Flora of the Latah Formation. By E. W. Berry.
- 154-I—*Exogyra Olisiponensis* Sharpe and *Exogyra Costata* Say in the Cretaceous of the Western Interior. By J. B. Reeside.
- 154-J—Additions to the Flora of the Green River Formation. By R. W. Brown.
- 157 —The Mother Lode System of California. By A. Knopf.

- 158-A—The Occurrence and Origin of Analcite and Meerschaum Beds in the Green River Formation of Utah, Colorado and Wyoming. By W. H. Bradley.

**Bulletins:**

- 794 —Red Beds and Associated Formations in New Mexico.  
 797-B—The Skwentna Region, Alaska. By S. R. Capps.  
 797-E—Aerial Photographic Surveys in Southeastern Alaska. By R. H. Sargent and F. D. Moffit.  
 797-F—Geology and Mineral Resources of the Aniakchak District, Alaska. By R. S. Knappen.  
 801 —Geology and Water Resources of the Edgely and La Moure Quadrangles, North Dakota. By H. A. Hard.  
 803 —Geography, Geology, and Mineral Resources of the Portneuf Quadrangle, Idaho. By G. R. Mansfield.  
 804 —Geology and Coal and Oil Resources of the Hanna and Carbon Basins, Carbon County, Wyoming. By C. E. Dobbin, C. F. Bowen and H. W. Hoots.  
 805 —Contributions to Economic Geology, 1928. Part 1—Metals and Nonmetals Except Fuels. By G. F. Loughlin and G. R. Mansfield.  
 805-B—Deposits of Vermiculite and Other Minerals in the Rainy Creek District near Libby, Montana. By J. T. Pardee and E. S. Larsen.  
 806-B—The Northward Extension of the Sheridan Coal Field, Big Horn and Rosebud Counties, Montana. By A. A. Baker.  
 806-C—Geology and Oil and Gas Prospects of Part of the San Rafael Swell, Utah. By J. Gilluly.  
 806-D—Geology of the Rock Creek Oil Field and Adjacent Areas, Carbon and Albany Counties, Wyoming. By C. E. Dobbin, H. W. Hoots, C. H. Dane and E. T. Hancock.  
 806-E—Thrust Faulting and Oil Possibilities in the Plains Adjacent to the Highwood Mountains, Montana. By F. Reeves.  
 807 —Geology of Hyder and Vicinity Southeastern Alaska, with a Reconnaissance of Chickamin River. By A. F. Buccington.

**Water Supply Papers:**

- 593 —Surface Water Supply of the United States, 1924. Part 12—North Pacific Slope Drainage Basins. B—Snake River Basin. By N. C. Grover.  
 594 —Surface Water Supply of the United States, 1924. Part 12—North Pacific Slope Drainage Basins. C—Lower Columbia River Basin and Pacific Slope Drainage Basins in Oregon. By N. C. Grover.  
 595 —Surface Water Supply of Hawaii, July 1, 1923 to June 30, 1924. By N. C. Grover.  
 597-B—A Study of Ground Water in the Pomperaug Basin, Connecticut. By O. E. Meinzer and N. D. Stearns.  
 597-C—Problems of the Soft-Water Supply of the Dakota Sandstone. By O. E. Meinzer.  
 597-D—Geology and Water Resources of the Upper McKenzie Valley, Oregon. By H. T. Stearns.  
 597-E—Surface Water Supply of the Sacramento River Basin, California, 1895–1927. By H. D. McGlashan.  
 611 —Surface Water Supply of the United States 1925. Pacific Slope Basins in California.  
 612 —Surface Water Supply of the United States, 1925. North Pacific Slope Drainage Basins. Pacific Basins in Washington and Upper Columbia River Basin.  
 636-A—Quality of Water of the Colorado River in 1926–1928. By C. S. Howard.

**U. S. Bureau of Mines:**

**Technical Papers:**

- 410 —Falls of Roof in Bituminous Coal Mines. By J. W. Paul.  
 448 —Coal-Dust Explosions in Mines.

- 449 —A Study of the Crude Oil Produced in the Salt Creek Field Wyoming.  
 450 —Inflammability of Mixed Gasses. By G. W. Jones.  
 451 —Calcium Sulphate Retarders for Portland Cement Clinker. By E. E. Berger.  
 452 —Safety Organizations in Arizona Copper Mines.

#### Bulletins:

- 285 —Coal-Mine Ventilation Factors. By H. P. Greenwald and G. L. McElroy.  
 290 —Bibliography of Petroleum and Allied Substances, 1922 and 1923.  
 298 —Methods, Costs, and Safety in Stripping and Mining Coal, Copper Ore, Iron Ore, Bauxite and Pebble Phosphate.  
 305 —Inspection and Testing of Mine-Type Electrical Equipment for Permissibility.

#### Mineral Resources of the United States:

- Petroleum Refinery Statistics, 1927. By G. R. Hopkins.  
 Precipitation of Lead and Copper from Solution on Sponge Iron. By G. L. Oldright, H. E. Keyes, V. Miller and W. A. Sloan.  
 Metallurgical Limestone. Problems in Production and Utilization. By O. Bowles.  
 Factors Governing the Entry of Solutions Into Ores During Leaching. By J. D. Sullivan, W. E. Keck, and G. L. Oldright.  
 Coke and By-Products in 1927. By F. G. Tryon and H. L. Bennit.  
 Zinc in 1927. By E. W. Pehrson.  
 Recent Articles on Petroleum and Allied Substances, May, 1929.  
 Fuel Briquets in 1928. By O. E. Kiessling and J. M. Corse.  
 Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1927. By C. W. Henderson.  
 Coal in 1927.  
 Petroleum in 1927.  
 Secondary Metals in 1927.  
 Rare Metals in 1927.  
 Coke-Oven Accidents in the United States During the Calendar Year 1927. By W. W. Adams.  
 Terminology in Coal Research. By R. Thiessen and W. Francis.  
 Graphical Terrane Correction for Gravity Gradient. By D. C. Barton.  
 Advanced Mine Rescue Training. Part 3—Protection Against Gases Encountered in Mines. By J. J. Forbes and G. W. Grove.  
 Pacific Coast Petroleum Shipments. By E. T. Knudsen.  
 Iron Oxide Reduction Equilibria.  
 Carburetion of Combustible Gas With Butane and Propane-Butane Mixtures.  
 Lead in 1927.  
 Cadmium in 1927.  
 The Blast-Furnace Stock Column. By S. P. Kinney.  
 Use of a Type N Miners' Gas Mask. By S. H. Katz and G. S. McCaa.  
 Specific Heats of Gases at High Temperatures. By E. D. Eastman.  
 Summarized Data of Zinc Production. By E. W. Pehrson.

#### Reports of Investigations:

- 2923—Relative Ageing Properties of Gelatin Containing Nitroglycerin and Ethylene Glycol Dinitrate. By A. B. Coates and G. St. J. Perrott.  
 (Gives results of tests made to determine relative effects on rate of detonation, propulsive strength and sensitiveness produced on low-freezing gelatin dynamites containing ethylene glycol dinitrate and regular dynamites containing nitroglycerin in long periods of storage.)  
 2924—Batch Classification in the Laboratory. By A. W. Fahrenwald and Clarence Thom.  
 (Describes a batch laboratory classifier and elutriator developed for use in conjunction with other batch laboratory apparatus such as batch ball mills, flotation machines and tables.)



- 2925—Losses of Phosphate in the Land-Pebble District of Florida. By H. M. Lawrence.  
(Summarizes suggested improvements in washing practice which should result in recovering certain losses in the finer sizes of phosphate pebble.)
- 2926—The Reduction of Cuprous Oxide by Carbon Monoxide. By Chas. G. Maier.  
(Deals with the calculation of gas concentrations in the reduction of cuprous oxide, which have a bearing on the bright annealing of copper.)
- 2927—A new Type of Laboratory Dust-Explosion Apparatus. By C. M. Bouton, C. H. Gilmour and Garnet Phillips.  
(Describes apparatus developed by Bureau of Mines for use in studying explosibility of industrial dusts, particularly coal dust.)
- 2928—Official Changes in the Active List of Permissible Explosives and Blasting Devices for April, 1929.  
(Supplements active list of permissible explosives published June 1, 1928, as Serial 2879 and Serials 2891, 2900, 2907, 2915 and 2922, giving changes in the active list.)
- 2929—The study of a Fundamental Basis for Controlling and Gauging Natural Gas Wells. Part 1. Computing the Pressure at the Sand in a Gas Well. By H. R. Pierce and E. L. Rawlins.
- 2930—The Study of a Fundamental Basis for Controlling and Gauging Natural Gas Wells. Part 2. A Fundamental Relation for Gauging Gas Well Capacities. By H. R. Pierce and E. L. Rawlins.  
(These two reports discuss the problem of gauging the capacity of gas wells to deliver gas under different pressure conditions.)
- 2931—Consumption of Reagents Used in Flotation, 1927. By A. M. Gaudin.  
(Includes statistics regarding tonnage of ore treated by flotation and reagent consumption in treatment of various types of ores.)
- 2932—A Staining Method for Distinguishing Cerussite and Anglesite in Ores, Concentrates, and Tailings. By R. E. Head and A. L. Crawford.  
(Outlines method of differentially coloring finely crushed minerals of the type named as a means for their identification to facilitate sight recognition of the minerals under the microscope.)
- 2933—Effect of Sieve Motion on Screening Efficiency. By A. W. Fahrenwald and S. W. Stockdale.  
(Gives results of study of effect of vibration of sieve surface on passage of grains of ore through screens, and discusses relative effectiveness of various motions employed in screen operation.)
- 2934—Dissolution of Various Oxidized Copper Minerals. By J. D. Sullivan.  
(Gives data regarding time required to dissolve in sulphuric acid and ferric sulphate solutions various copper minerals present in ores, and consumption of reagents used in dissolving the minerals. Has bearing on recovery of copper by leaching methods from low-grade disseminated ore.)
- 2935—The Effect of Substituting Ethylene Glycol Dinitrate in Permissible Explosives. By G. St. J. Perrott and J. E. Tiffany.  
(Gives results of tests to determine effect on safety and physical properties of permissible explosives of substituting ethylene glycol dinitrate for nitroglycerine or mixture of nitroglycerine and nitropolyglycerine.)
- 2936—Beneficiation of Oxidized Manganese Ores by Magnetic Separation of Roasted Jig Concentrates. By F. D. DeVaney and W. H. Coghill.  
(Outlines method by which certain manganese ores too high in iron to be used to make ferro-manganese may be brought up to ferro grade.)
- 2937—Gravity concentration of Alabama Oolitic Iron Ores. By F. D. DeVaney, B. W. Gandrud, and W. H. Coghill.

- (Gives results of method for gravity concentration of ores of excessive silica content, of which the Birmingham district contain large reserves hitherto not amenable to successful treatment.)
- 2938—The National Safety Competition of 1928. By W. W. Adams.  
(Gives names of winners and statistical details of an accident-prevention contest participated in by 284 mines and quarries.)
- 2939—Gas—Solid Contact in the Shaft of a 700-Ton Blast Furnace. By S. P. Kinney and C. C. Furnas.
- 2940—A Method for Studying Factors Influencing the Rate of Burning and Pressure Development of Black Blasting Powder. By A. I. Coates and J. E. Crawshaw.
- 2941—Official Changes in the Active List of Permissible Explosives and Blasting Devices for May, 1929.
- 2942—Flow of Natural Gas Through High-Pressure Transmission Lines. By T. W. Johnson and W. B. Berwald.  
(Gives details of field tests designed to compare deliveries calculated from gas pipe-line flow formulas commonly used, with metered deliveries from pipe lines in operation.)
- 2943—Tests of Bituminous Coking Coal in a Large Low-Pressure Heating Boiler. By P. Nicholls, C. E. Augustine and B. A. Landry.  
(Supplements Technical Paper 303, published in 1922, and discusses results of additional tests made to determine how production of smoke and efficiency of boiler have been affected by certain modifications made in design of the boiler used.)
- 2944—Accidents in Metal Mines Due to Falls of Men and Material. By F. D. Cannon.  
(Gives statistics regarding accidents of this nature, which cause more than one-third of total accidents in metal mines; outlines measures recommended for prevention of such accidents.)
- 2945—The Disposal of Oil Field Brines. By Ludwig Schmidt and John M. Devine.  
(Outlines various methods for disposing of brines produced with crude petroleum and natural gas, which have been a source of trouble to oil and gas operators and to farmers and stock-raisers in vicinity of producing fields.)
- 2946—Some Operating Results on Small Heating Plant Stokers. By J. F. Barkley.  
(Discusses results of operating tests of a hand stoker and an electrically-operated mechanical stoker using two kinds of coal.)

#### Information Circulars:

- 6109—The National Safety Competition to Assist in the Reduction of Mine and Quarry Accidents. By W. W. Adams.  
(Describes annual safety contest, conducted under the auspices of the Bureau of Mines, in which 300 mines and quarries participate.)
- 6110—Review of State Mine Inspector's Reports as They Relate to Accidents from Falls of Roof. By J. W. Paul.  
(Summarizes reports made by State mine inspectors relative to accidents from falls of mine roof, published as a feature of special study of the subject being made by Bureau of Mines.)
- 6111—Mining Laws of China. By John W. Frey.  
(The sixth in a series of digests of foreign mining legislation and court decisions relative to rights of American citizens to explore for minerals and to own and operate mines in various foreign countries.)
- 6112—What Do We Know About the Explosibility of Coal Dust in Mines. By H. P. Greenwald.
- 6113—Method and Cost of Mining Zinc and Lead at No. 1 Mine, Tri-State Zinc and Lead District, Picher, Oklahoma. By Wm. F. Netzeband.
- 6114—Survey of Gravities of Domestic Crudes. By G. R. Hopkins and A. B. Coons.
- 6115—Fusain. By Joseph D. Davis.

- 6116—Petroleum Refineries in the United States January 1, 1929. By G. R. Hopkins and E. W. Cochrane.
- 6117—Activities of the Holmes Safety Association in Florida. By F. E. Cash.
- 6118—Graphite. By Paul M. Tyler.
- 6119—Method and Cost of Mining the Thick Freeport Coal in a Western Pennsylvania Mine. By J. W. Paul and H. Tomlinson.
- 6120—Geophysical Abstracts. No. 1. By Frederick W. Lee.
- 6121—Method and Cost of Mining Zinc and Lead at Mine No. 2, Tri-State District, Picher, Oklahoma. By Wm. F. Netzeband.
- 6122—Graphite. Part 2. Domestic and Foreign Deposits. By Paul M. Tyler.
- 6123—Graphite. Part 3. Utilization of Graphite. By Paul M. Tyler.
- 6124—Graphite. Part 4. Status of the American Graphite Industry. By Paul M. Tyler.
- 6125—The Free Energy of Water, Carbon Monoxide, and Carbon Dioxide. By E. D. Eastman.
- 6126—Some Phases of Coal Mine Ventilation. By J. J. Forbes and M. J. Ankeny.
- 6127—Survey of Cracking Plants, January 1, 1929. By G. R. Hopkins. (Contains list of oil-cracking plants in United States with details as to location, number of units, daily charging capacity and type of process used.)
- 6128—The Holmes Safety Association, Its Objectives, and Its Work in the Uniontown-Brownsville Region of Pennsylvania. By G. W. Grove.  
(Outlines work in this region of this organization which has as its objective the improvement of health and safety conditions among the employees of the mining industries.)
- 6129—Sampling Dust in Rock-Dusted Mines. By C. W. Owings.  
(Gives instructions as to methods of sampling dusts in rock-dusted mines to determine percentage of incombustible material as a guide to adequacy of rock-dusting.)
- 6130—The Unusually Good Safety Record of a Coal Mine and of a Coal-Mine Foreman. By E. H. Denny.  
(Gives details of remarkable safety record made by Colorado Fuel and Iron Company's Robinson No. 1 Mine, Walsen, Colorado, and by David Muir, foreman of the mine, in operating since July, 1915, without a fatal accident.)
- 6131—Mining Laws of Colombia. By A. D. Garman.  
(Discusses rights of aliens, prospecting, concessions, etc.)
- 6132—Ocher and Ochery Earths. By R. M. Santmyers.  
(Gives information regarding uses, specifications and color variations of ocher, methods of mining and treatment, and domestic deposits. Discusses French ocher industry.)
- 6133—Geophysical Abstracts. No. 2. By Frederick W. Lee.
- 6134—Safeguarding Electrical Equipment Used in Gassy Mines. European Practice: I—Great Britain.  
(Summarizes British regulations covering installation and use of electrical equipment in mines and outlines tests and requirements for electric motor and flame-proof equipment.)
- 6135—Safeguarding Electrical Equipment Used in Gassy Mines. European Practice: II—Belgium. By L. C. Ilsley.  
(Outlines Belgian requirements for explosion-proof electrical machinery and methods used in testing electrical mine equipment.)
- 6136—Progress in Metal Mine Ventilation. By D. Harrington.  
(Summarizes recent developments in cooling of mine air, combating metal mine dusts and preventing and controlling metal mine fires.)
- 6137—Work of the Holmes Safety Association in the State of Washington. (Summarizes safety and welfare activities of this organization in coal-mining industry of Washington.)
- 6138—Method and Cost of Mining Hard Specular Hematite on the Marquette Range, Michigan. By Lucien Eaton.



- (Outlines methods of prospecting and exploration, sampling and estimating tonnage and values and development methods. Give data regarding percentage of ore extraction and costs in unit of labor, fuel and supplies.)
- 6139—Recommendation for Safety in Coal Mining Relating to Placing Main Haulage in Intake Air. By the Mine Safety Bureau.
- 6140—Mining Laws of Bolivia. By A. D. Garmah.
- 6141—Tentative Method for Making Resistivity Measurement of Drill Cores and Hand Specimens of Rocks and Ores. By M. W. Pullen.
- (The first of a series of papers dealing with measurement of geophysical constants designed to aid in mineral prospecting. Presents a tentative method and the results of tests of drill cores from the Mineville, New York, magnetite district and other hand specimens of serpentine and chromite.)
- 6142—Mineral Wool. By J. R. Thoenen.
- (Describes methods used in preparation of rock wool and slag wool, used extensively for insulating and other purposes.)
- 6144—A Gas Explosion in a Rock-Dusted Mine. By G. S. McCaa.
- (Describes a gas explosion which occurred in a well rock-dusted bituminous coal mine, and which exemplifies the value of rock dusting, the necessity of maintaining effective ventilation, and the need of permissible rock-dusting machines receiving power from a permissible locomotive.)
- 6145—Mining Methods at Minas de Matahambre, Matahambre, Pinar Del Rio, Cuba. By George L. Richert.
- 6146—Safeguarding Electrical Equipment Used in Gassy Mines. European Practice: IV—France. By L. C. Ilsley.
- 6147—Hazards in the Use of Delay-Action Detonators in Coal Mines. By D. Harrington and S. P. Howell.
- 6148—Selected Bibliography of Minerals and Their Identification. By Oliver Bowles.
- 6149—Mining Methods of the Tennessee Copper Company, Ducktown, Tennessee. By C. H. McNaughton.

#### Economic Papers:

Strontium from a Domestic Standpoint. By R. M. Santmyers.

#### Miner's Circulars:

Advanced Mine Rescue Training. Part 3—Protection Against Gases Encountered in Mines.

#### U. S. Bureau of Foreign and Domestic Commerce:

##### Monthly Summaries of Foreign Commerce of the U. S.:

- Part 2, January, 1929.
- Part 1, February, 1929.
- Part 2, February, 1929.
- Part 1, March, 1929.
- Part 2, March, 1929.
- Part 1, April, 1929.
- Part 2, April, 1929.
- Part 1, May, 1929.

#### U. S. Bureau of Standards:

##### Circulars:

Recommended Specification for Quicklime and Hydrated Lime for Use in Making Soap.

Diamond Core Drill Fittings.

#### Alabama Geological Survey:

##### Circulars:

- 6—Summary Report on the Wattsville Basin of the Coosa Coal Field. By W. B. Jones.
- 8—Summary Report on the Building Limestones of the Russellville District. By W. B. Jones.
- 9—Summary Report on Graphite in Alabama. By W. B. Jones.

- 10—Possible Salt Deposits in the Vicinity of the Jackson Fault, Alabama.  
By J. Barksdale.

Arkansas Geological Survey:

Upper Cretaceous Ostracoda of Arkansas. By M. C. Israelsky.

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Idaho Bureau of Mines and Geology:

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Illinois State Geological Survey:

The Gastropod Genus *Yvania*. By J. M. Weller.

Bulletin 42—Engineering and Legal Aspects of Land Drainage in Illinois.  
By G. W. Pickels and F. B. Leonard.

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The Geology and Mineral Resources of Kentucky. By W. R. Jillson.

Michigan Geological Survey:

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New Jersey State Department of Conservation and Development:

Bulletin 30—Ground Water Supplies of the Atlantic City Region. By  
D. G. Thompson.

Bulletin 31—The Mineral Industry of New Jersey for 1926. By M. E.  
Johnson.

Bulletin 32—The Mineral Industry of New Jersey for 1927. By M. E.  
Johnson.

Oklahoma Geological Survey:

List of Available Publications, March, 1929:

Bulletin 14—Chemical Analyses of Oklahoma Mineral Raw Materials.  
By A. C. Shead.

Bulletin 46—The Pennsylvanian System in the Ardmore Basin. By C. W.  
Tomlinson.

Circular 18—A comparative Faunal Chart of the Mississippian and Mor-  
row Formations of Oklahoma and Arkansas. By R. Roth.

Argentina Republica:

Publications:

49—Estadística de Petróleo de la República Argentina.

50—Las Minas de Hierro de Lagunillas. Por N. A. Lannefors.

51—El Mineral de Hierro de Lagunillas y su Valor Metalúrgico. Por S.  
Wassman.

Barcelona, Spain: Memorias de la Real Academia de Ciencias y Artes:

Estudio de las Superficies de los Cristales como Base y Fundamento de un  
Cálculo Cristaleográfico Diferente del Usual. By D. J. Goizueta  
y Díaz.

Contribución al Estudio de los Sarcosporidios. By D. S. Alcobe y Noguer.  
Un Nuevo Método Independiente Para Medir la Dimensión y Distancia  
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Volume 4, Nos. 3 and 4.

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Volume 5—da série E 3 dos docs da bib. nac.

Volume 6—da série 4 dos docs da bib. nac.

Volume 7—da série 5 dos docs da bib. nac.

## Bulgarian Geological Society :

Volume 1, Part 3. 1928.

## Canada Department of Mines :

Report, for the fiscal year ending March 31, 1928.

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Industrial Fuel and Power Statistics for Ontario. 1925. By E. S. Malloch and C. E. Baltzer.

## England &amp; Wales Geological Survey Memoirs :

Wells and Springs of Derbyshire.

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The Geology of the Country Around Sudbury (Suffolk).

The Geology of the Country Around Aldershot and Guildford.

## Finlande Commission Geologique :

Numbers 70-79, Volume 12.

Numbers 85 and 86.

## Great Britain Geological Survey :

Attrition Tests of British Road-stones.

## Japanese Imperial Geological Survey :

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Report 101.

Report 102.

Journal of the Faculty of Science. Volume 2, Part 8.

The Oil Fields of the Japanese Empire, Section 20.

Report 98.

Report 99.

Report 100.

## Lima, Peru : Ministerio de Fomento :

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## Mexico : Secretaria de Industria, Comercio y Trabajo, Departamento de Petroleo.

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Anuario de Estadistica Minera. 1926.

Tomo 27, Numero 3. Marzo de 1929.

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Annual report of the Department of Mines for the Year 1928.

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The Geology of the Waiapu Subdivision, Raukumara Division.

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Thirty-seventh Annual Report of the Ontario Department of Mines, Volume 37, Part 4, 1928.

May Gold Bulletin. June 13, 1929.

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The Philippine Journal of Science and Other Publications of the Bureau of Science.

Twenty-sixth Annual Report of the Bureau of Science, for the Year Ending Dec. 31, 1927. By W. H. Brown.

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December, 1928.

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Geografja, Paleontologja, Krystallografja i Geologja. Volume 6-1.

## Queensland Geological Survey :

Geology of the Bowen River Coal Field.

## South Australia Department of Mines :

Annual Report of the Director of Mines and Government Geologist for 1928.

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Reports of the Executive Committee, Gold Producers Committee and Collieries Committee for Year 1928.

## Societies and Educational Institutions.

## Academy of Natural Sciences of Philadelphia :

Year Book. Dec. 31, 1928.

## American Association of Petroleum Geologists :

Notes on California Oil Field Practice. By R. E. Collom.

## American Bureau of Metal Statistics :

Yearbook. Ninth Annual Issue, 1928.

## American Geographical Society :

Geological Review, April, 1929.

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## American Mining and Metallurgical Manual :

Thirty-ninth Annual, 1929.

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The List of the American Philosophical Society Held at Philadelphia for Promoting Useful Knowledge. May, 1929.

Proceedings of the American Philosophical Society. Volume 68, No. 1. 1929.

## California Academy of Sciences :

Volume 17—Numbers 11 and 12. Report of the President of the Academy for the Year 1928. By C. E. Grunsky. Report of the Director of the Museum for the Year 1928. By B. W. Evermann.

Volume 18—Number 4. Marine Miocene and Related Deposits of North Colombia. By F. M. Anderson.

Numbers 5, 6, 7, and 8. A New Pecten from the San Diego Pliocene. By L. G. Hertlein. A New Species of Land Snail from Kern County, California. By G. D. Hanna. A New Species of Land Snail from Coahuila, Mexico. By G. D. Hanna and L. G. Hertlein. Some notes on Oreohelix. By J. Henderson.

Number 9. Notes on the Northern Elephant Seal. By M. E. McL. Davidson.

Number 10. On a Small Collection of Birds from Torres Strait Islands and from Guadalcanar Island, Solomon Group. By M. E. McL. Davidson.

Number 11. The Generic Relationships and Nomenclature of the California Sardine. By C. L. Hubbs.

Number 12. The Faunal Areas of Southern Arizona: A Study in Animal Distribution. By H. S. Swarth.

## California State Library :

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## Bulletins :

204—April, 1929.

205—May, 1929.

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Report of the Executive Council for the Year 1928.

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Morphology of the Blood Vascular System of the Tiger Salamander. B.  
R. J. Gilmore and F. J. Figge.

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Volume 11, 1914-1923.

Volume 12.

## Economic Geology :

General Index. Volumes 1-20. 1905-1925. By J. M. Nickles.

Volume 24, No. 3. May, 1929.

Volume 24, No. 4. June-July, 1929.

## Field Museum of Natural History :

Annual Report of the Director to the Board of Trustees for the Year 1928  
Publication 260, Volume 5, No. 2, Geological Series. The Mineral Com-  
position of Some Sands from Quebec, Labrador and Greenland  
By J. H. C. Martens.

## Fourth Pacific Science Congress, Batavia-Java :

On the Formation of Caldera's. By B. G. Escher.

## Harvard University: Mineralogy and Petrography :

## Numbers :

55—Paragenetic Classification of the Minerals of Franklin, New Jersey

56—A Comparison of the Ore Deposits of Langban, Sweden, with those  
of Franklin, New Jersey.

57—The Stock of the Alkaline Rocks near Libby, Montana.

59—The Temperatures of Magmas.

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## Bulletins :

295—April, 1929.

296—May, 1929.

297—June, 1929.

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Volume 34, No. 4. April, 1929.

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Thirty-fourth Annual Report for the Year 1928.

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Bulletin 200—Volume 22, No. 3. March, 1929.

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Bulletin 203—Volume 22, No. 6. June, 1929.

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Constitution, By-Laws and Rules.

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Journal of the Mineralogical Society of America. Volume 14, No. 6  
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Minnesota School of Mines Experiment Station:

Mining Directory of Minnesota 1929. By J. J. Craig.

Museum of Natural History of Cleveland:

Episodes of the Amundsen-Ellsworth Arctic Flights.

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Canadian Journal of Research. May, 1929.

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Technical Bulletin No. 5.

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Volume 45:

Number 1. February, 1929.

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Memoirs. Volume 1, No. 4a, No. 4b.

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Science Reports of the Tohoku Imperial University, Sendai, Japan:

Second Series, Volume 13, Nos. 1 and 2.

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Chemical and Industry Journal. Volume 48, No. 16.

South Dakota School of Mines:

Bulletin 16—The Mineral Wealth of the Black Hills. By J. P. Connolly and C. C. O'Harra.

Tulsa Public Library:

Abstracts of Articles on Petroleum from Various Magazines.

University of California:

Correlation and Affinities of Certain Species of Pitaria. By N. M. Tegland.  
Artiodactyla from the Fossil Beds of Fish Lake Valley, Nevada. By R. A. Stirton.

Geology of the Marysville Buttes, California. By H. Williams.

A Contribution to the Paleontology of the Fernando Group, Ventura County, California. By L. N. Waterfall.

Metallization from Basic Magmas. By C. D. Hulin.

Heat Transfer from Tubes to Liquids in Viscous Motion. By F. W. Dittus.

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Bulletin 245.

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Minnesota Chats.

University of Missouri:

Mines and Metallurgy Bulletin, August, 1928.

Universite de Strasbourg:

Bulletin du Service de la Carte Geologique D'Alsace et de Lorraine.  
Tome 1, Fascicule 3.



**Other Publications.**

- Address Delivered by Mr. A. W. Rogers, President of the Transvaal Chamber of Commerce. March, 1929.
- A Newly Found Meteoric Stone Reported by W. B. Lang from Peck Spring, Midland County, Texas. By G. P. Merrill.
- Agenda for General Conference on Diamond Core Drill Fittings. May, 1929.
- Annual Report of the Treadwell Yukon Co. for the Year Ending December 31, 1928.
- Experiments in Connection with Salt Domes. By B. G. Escher and H. Kuenen.
- Feuerfest Ofenbau. February, 1929.
- Hearings Before the Committee on Mines and Mining, U. S. Senate, 70th Congress, 2d Session on S. 2079 Part 2, February 15, 1929.
- Need of Unified Law for Surface and Underground Water. By S. C. Wiegman.
- Report on Cooperation Between the Territory of Alaska and the United States in Making Mining Investigations and in the Inspection of Mines for the Biennium Ending March 31, 1929.
- Report of the Joint Committee of the Senate and Assembly, Dealing with the Water Problems of the State of California. January 18, 1929.
- Reprint from 2 Southern California Law Review, 358-369.
- The Chase Architrave.
- The Iron and Manganese Ores of the Nordmark District. By N. H. Magnusson.
- Twenty-third Annual Report of the United States Smelting, Refining and Mining Company. December 31, 1928.

**Books.**

- Digest of the Delaware Corporation Law. 1929.
- John Hays Hammond Public Mining Library:
- Catalytic Action. By K. G. Falk.
- Lubricating Greases. By E. N. Klemgard.
- Motor Fuels, Their Production and Technology. By E. H. Leslie.
- Industrial Chemistry, An Introduction. By E. R. Riegel.
- Properties of Inorganic Substances. By W. Segerblom.
- Metallography. By G. Tammann.
- Marine Products of Commerce. By D. K. Tressler.
- The Condensed Chemical Dictionary.
- Modern Pulp and Paper Making. By G. S. Witham, Sr.
- Industrial Filtration. By A. Wright.
- The Chemical Effects of Alpha Particles and Electrons. By S. C. Lind.
- Organic Compounds of Mercury. By F. C. Whitmore.
- Industrial Hydrogen. By H. S. Taylor.
- Zirconium and Its Compounds. By F. P. Venable.
- The Properties of Electrically Conducting Systems. By C. A. Kraus.
- Valence and the Structure of Atoms and Molecules. By G. N. Lewis.
- Colloid Chemistry. The Svedberg.
- The Structure of Crystals. By W. G. Wyckoff.
- The Recovery of Gasoline from Natural Gas. By G. A. Burrell.
- Molybdenum, Cerium and Related Alloy Steels. By H. W. Gillett and E. L. Mack.
- Shale Oil. By R. H. McKee.
- Equilibria in Saturated Salt Solutions. By W. C. Blasdale.
- Titanium. By W. M. Thornton, Jr.
- Phosphoric Acid, Phosphates and Phosphatic Fertilizers. By W. H. Waggaman.
- Noxious Gases. By Y. Henderson and H. W. Haggard.
- Hydrochloric Acid and Sodium Sulphate. By N. A. Laury.
- The Properties of Silica. By R. B. Sosman.
- Protective Metallic Coatings. By H. S. Rawdon.
- Soluble Silicates in Industry. By J. G. Vail.
- The Industrial Development of Searles Lake Brines. By J. E. Teeple.

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U. S. G. S. Topographic Maps.

California :

Lassen Volcanic National Park.  
Laguna Quadrangle. Arizona-California.  
Guernsey Quadrangle. Kings County.

Japan :

Sheets :

131—Sagara, Zone 28, Col. 8.  
167—Asuke, Zone 26, Col. 10.  
173—Toyohashi, Zone 27, Col. 10.  
179—Irakozaki, Zone 28, Col. 10.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended :

American Petroleum Institute, New York.  
Architect and Engineer, San Francisco.  
Arizona Mining Journal, Phoenix, Arizona.  
Asbestos, Philadelphia, Pennsylvania.  
Brick and Clay Record, Chicago.  
Bulletin, Union Oil Co., Los Angeles.  
California Journal of Development, San Francisco.  
Cement, Mill and Quarry, Chicago, Illinois.  
Chemical-Engineering and Mining Review, Melbourne, Australia.  
Engineering and Mining Journal, New York.  
Explosives Engineer, Wilmington, Del.  
Financial Insurance News, Los Angeles, California.  
Graphite, Jersey City.  
Journal of Electricity and Western Industry, San Francisco.  
Mine and Quarry, Chicago.  
Mining and Engineering Record, Vancouver, B. C.  
Mining and Oil Bulletin, Los Angeles.  
Oil Age, Los Angeles.  
Oil and Gas Journal, Tulsa, Oklahoma.  
Oil and Gas News, Kansas City.  
Oil News, Galesburg, Illinois.  
Oildom, New York.  
Oil, Paint and Drug Reporter, New York.  
Oil Trade Journal, New York.  
Oil Weekly, Houston, Texas.  
Petroleum Age, New York.  
Petroleum Record, Los Angeles.  
Petroleum World, Los Angeles.  
Queensland Government Mining Journal, Brisbane, Australia.  
Rock Products, Chicago, Illinois.  
Safety News, Industrial Accident Commission, San Francisco.  
Salt Lake Mining Review, Salt Lake City, Utah.  
Southwest Builder and Contractor, Los Angeles.  
Standard Oil Bulletin, San Francisco.  
Stone, New York.  
The Record, Associated Oil Company, San Francisco.  
Through the Ages, Baltimore.

Newspapers.

Amador Dispatch, Jackson, California.  
Barstow Printer, Barstow, California.  
Beaumont Gazette, Beaumont, California.  
Calaveras Prospect, San Andreas, California.  
California Miner, San Francisco, California.

California Oil World, Los Angeles, California.  
Colusa Daily Sun, Colusa, California.  
Daily Commercial News, San Francisco, California.  
Daily Midway Driller, Taft, California.  
Del Norte Triplicate, Crescent City, California.  
Denver Mining Record, Denver, Colorado.  
Exeter Sun, Exeter, California.  
Goldfield News, Goldfield, Nevada.  
Inyo Independent, Independence, California.  
Inyo Register, Bishop, California.  
Ione Valley Echo, Ione, California.  
Mojave Miner, Kingman, Arizona.  
Mountain Messenger, Downieville, California.  
Nevada City Nugget, Nevada City, California.  
Nevada Mining Press, Reno, Nevada.  
Oil Refinery News, Bayonne, New Jersey.  
Palo Verde Valley Times, Blythe, California.  
Placer Herald, Auburn, California.  
Plumas Independent, Quincy, California.  
San Diego News, San Diego, California.  
Shasta Courier, Redding, California.  
Siskiyou News, Yreka, California.  
Sotoyome Scimitar, Healdsburg, California.  
Stockton Record, Stockton, California.  
Tuolumne Prospector, Tuolumne, California.  
Waterford News, Waterford, California.  
Weekly Trinity Journal, Weaverville, California.  
Western Sentinel, Etna Mills, California.





## PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for MINING IN CALIFORNIA.



## EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the card containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.



## PUBLICATIONS OF THE DIVISION OF MINES AND MINING

During the past forty-eight years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines and Mining, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines and Mining.

NOTE.—The Division of Mines and Mining frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

### REPORTS

Asterisks (\*\*) indicate the publication is out of print.

	Price
*First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	-----
*Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	-----
*Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	-----
*Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	-----
*Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	-----
*Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	-----
*Part II, 1887, 222 pp., 36 illustrations. William Ireland, Jr.	-----
*Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Ireland, Jr.	-----



## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	Pr
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	\$14
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	3
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	2
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	2
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper	
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper	6
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper	6
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper	5
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	7
Mines and Mineral Resources of Plumas County, 188 pp., paper	5
Mines and Mineral Resources of Sierra County, 144 pp., paper	5

## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
Fifteenth Report of the State Mineralogist, 1920, Mining in California during 1920. Fletcher Hamilton: 562 pp., 71 illustrations, cloth-----	\$1.75
Sixteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy-----	0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties-----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
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Chapters of State Oil and Gas Supervisor's Report:	
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## BULLETINS

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Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper-----	



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- \*\*Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper-----

## MISCELLANEOUS PUBLICATIONS

- \*\*First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.-----
- \*\*Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.-----
- \*\*Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.-----
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- \*\*Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.-----
- \*\*Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.-----
- \*\*Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894-----
- \*\*Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper-----
- Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper-----
- Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923-----

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## MAPS

## Register of Mines With Maps.

- \*\*Register of Mines, with Map, Amador County-----
- \*\*Register of Mines, with Map, Butte County-----
- \*\*Register of Mines, with Map, Calaveras County-----
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- Register of Mines, with Map, Santa Barbara County (1906)-----\$0.25
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- \*\*Register of Mines, with Map, Sierra County-----
- \*\*Register of Mines, with Map, Siskiyou County-----
- \*\*Register of Mines, with Map, Trinity County-----
- \*\*Register of Mines, with Map, Tuolumne County-----
- Register of Mines, with Map, Yuba County (1905)-----.25
- Register of Oil Wells, with Map, Los Angeles City (1906)-----.35

## OTHER MAPS

- \*\*Map of California, Showing Mineral Deposits (50 x 60 in.)-----
- \*\*Map of Forest Reserves in California-----
- \*\*Mineral and Relief Map of California-----
- \*\*Map of El Dorado County, Showing Boundaries, National Forests-----
- \*\*Map of Madera County, Showing Boundaries, National Forests-----
- \*\*Map of Placer County, Showing Boundaries, National Forests-----
- \*\*Map of Shasta County, Showing Boundaries, National Forests-----

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Map of Desert Region of Southern California.....	----
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Map of Plumas County.....	----
Map of Trinity County.....	----
Map of Tuolumne County.....	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles.....	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin.....	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted.....	.75
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Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92 (also sold singly) In 4 colors.....	.50

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Map No. 36—Kettleman Hills, Kings County-----	1.2

## DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines and Mining for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determination will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.



# Mining in California



OCTOBER, 1929

PUBLISHED QUARTERLY

STATE OF CALIFORNIA  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF MINES

FERRY BUILDING  
SAN FRANCISCO

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*State Mineralogist*

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STATE OF CALIFORNIA  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF MINES  
FERRY BUILDING, SAN FRANCISCO

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ACTIVITIES OF THE DIVISION OF MINES





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Editorial Office: The Journal of the Royal Anthropological Institute, 21, Bedford Square, London WC1N 3AU, UK  
Telephone: +44 (0)20 7612 9830, Fax: +44 (0)20 7612 9831, Email: [editorial@rapinstitute.org](mailto:editorial@rapinstitute.org)

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## PREFACE

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The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing this was changed to quarterly publication, beginning in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the Division of Mines.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued, as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

## STATE MINERALOGIST.

## SCALE



- M E X I C O

## DISTRICT REPORTS OF MINING ENGINEERS

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In 1919-1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

### New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock being in need of revision, it was deemed advisable, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program has been followed as near as possible in succeeding numbers of the quarterly.

### REDDING FIELD DIVISION

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field Division, as Mr. Chas. V. Averill, District Mining Engineer in charge, has been temporarily assigned to field work in the San Francisco and Sacramento Divisions.



## SACRAMENTO FIELD DIVISION

### GLENN COUNTY

By CHAS. VOLNEY AVERILL, Mining Engineer

#### Geography and Topography.

Glenn County is one of the Sacramento Valley counties, with the Sacramento River forming its eastern boundary. The eastern half is valley land; but the western half extends well into the Coast Range Mountains; and a large part of it is included in the California National Forest. This national forest was created partially for the protection of the watershed of Stony Creek, which furnishes water to the Orland Reclamation Project. Willows, the county seat, is about 90 miles by road north of Sacramento. According to the 1920 census, the population of the county is 11,853 persons.

#### Climate.

Like those of the rest of the Sacramento Valley region, the seasons consist essentially of a rainy winter and a long summer season that is warm and dry. A large part of Glenn County lies in a warm belt that is particularly favorable to the raising of citrus fruits without the use of orchard heaters.

#### Industries.

Agriculture is the chief industry; and the crop of navel oranges is the most profitable one. Prunes are next, with almonds and apricots following. Alfalfa is one of the major crops grown on irrigated lands and is used to support dairy herds. The product is absorbed by several local creameries. Cotton is increasing in importance; and a gin located at Hamilton City handled the crop from 3000 acres in 1928. Other important branches of the agricultural industry are the raising of grains, live stock and poultry.

The Glenn-Colusa canal system, which is fed by a large pumping plant on the Sacramento River, supplies water for irrigation in the Willows section. The Orland project, which receives water stored in Stony Creek in the Coast Range, has already been mentioned; while other lands are irrigated with water pumped from wells.

#### Transportation.

The main line of the Southern Pacific Railroad and one of the paved state highways run side by side across the eastern part of the county on a due north course. A branch of the railroad extends westerly from Willows to Fruto, which is about in the geographical center of the county. A second railroad line crosses from north to south very close to the Sacramento River. Three automobile roads branching from the main highway reach well out into the mountains of the western part of the county; while all points in the valley are accessible by means of numerous roads.

**Geology and Mineral Deposits.**

The formations of the county are sediments of various ages trending north and south in broad belts. On the east a belt of Quaternary sediments extends more than a third of the way across the county. This is followed by belts of Tertiary and Cretaceous, with the Jurassic on the extreme west.<sup>1</sup>

Very little mining or prospecting is being done in this county at present. During the war some chromite and manganese were produced; but since that time practically the only product has been miscellaneous stone, mostly for road and concrete work. The total recorded mineral output of the county is shown in the attached table.

**MINERAL PRODUCTION OF GLENN COUNTY, 1893-1928.**

Year	Amount	Value	Substance
93 and previous	3,319 long tons	\$49,700	Chromite.
09	140,000 tons	49,000	Macadam.
10	378,000 tons	34,020	Rubble.
11	421,775 tons	51,430	Sand and gravel.
12	543,675 tons	32,950	Sand and gravel.
13	416,640 tons	27,776	Sand and gravel.
14		30,553	Miscellaneous stone.
	746 lbs.	131	Copper.
15		46,526	Miscellaneous stone.
		10	Other minerals.
16		41,180	Miscellaneous stone.
		39,982	Other minerals.
17	879 tons	21,474	Chromite.
	369 tons	9,721	Manganese.
		33,260	Miscellaneous stone.
18		817	Other minerals.
	1,129 tons	57,263	Chromite.
		32,436	Miscellaneous stone.
19		58,137	Miscellaneous stone.
		1,500	Other minerals.
20		134,707	Miscellaneous stone.
21		103,197	Miscellaneous stone.
22		91,250	Miscellaneous stone.
23		113,282	Miscellaneous stone.
24		41,550	Miscellaneous stone.
25		92,288	Miscellaneous stone.
26		58,391	Miscellaneous stone.
27		63,869	Miscellaneous stone.
28		101,889	Miscellaneous stone.
Total		\$1,418,289	

<sup>1</sup> Geological Map of the State of California, State Mining Bureau, 1916.

## MINERAL RESOURCES

## BRICK CLAY

Bricks have been made from clay beds near Willows and Orland but not of recent years.

Bibl: State Mineralogist's Report XIV, p. 197; Bull. 38, p. 243.

## CHROMITE

*Black Diamond Group* is in Sec. 25, T. 22 N., R. 7 W., and originally included 14 claims. George O. Vanderford of Orland located the claims of this old group on January 1, 1929. 3000 tons of chromite were shipped from here in the early nineties, and other shipments were made in 1916. It is probable that considerable tonnages of ore of concentrating grade could be developed here. Transportation both of the concentrates and the water to operate the mill would be difficult because of the location of the mine high up on the steep side of Red Hill.

Bibl: State Mineralogist's Reports XII, p. 36; XIV, p. 198; Bull. 38, p. 268; Bull. 76, p. 146.

*Conklin and Williams Claims* were in Sec. 3, T. 22 N., R. 7 W. This is U. S. government land, and is probably open to location at the present time. Small lenses of high-grade chromite up to 2 feet in width were found here.

Bibl: State Division of Mines Bull. 76, p. 147.

*Luce Claims.* A. Luce of Willows mined chromite during the war from some claims located in Sec. 1 or 12, T. 21 N., R. 7 W.

Bibl: State Division of Mines Bull. 76, p. 219.

State Division of Mines Bulletin 76, 'Manganese and Chromium in California,' 1918, mentions several other chromite prospects in Glenn County; but no chromite is being produced at the present time.

## COAL

At one time work was done on several small coal veins on the west side of the valley by the *Glenn County Oil and Coal Company*; but nothing of consequence was developed.

Bibl: State Mineralogist's Report XIV, p. 197.

## COPPER

Copper indications have been found at several points in the western part of the county; but nothing of importance has been developed. F. C. Bedford of Willows holds some claims northwest of the Elk Cree post office, where chunks of ore containing native copper were found in a tunnel 30 years ago. The ore found was not in place. During the past few years a shaft has been sunk to a depth of 70 feet without favorable results.

Bibl: State Mineralogist's Report XIV, p. 197.



## GOLD

Gold has been found near Millsaps, and a little work done; but nothing of consequence developed.

Bibl: State Mineralogist's Reports XII, p. 132; XIV, p. 198.

*Titanic Mining Company* held a group of claims in T. 21 N., R. 7 W., half mile west of the Geo. Gillaspay ranch, some years ago. A little prospecting was done on some small stringers said to contain values in gold, silver and copper. This is U. S. government land, and is probably open ground now.

Bibl: State Mineralogist's Report XVIII, p. 263.

## GRANITE

A dike of syenitic granite in sandstone has been reported in Sec. 8, 18 N., R. 4 W. This section is now owned by T. Talbot Anderson, Aliler Ave., Volanda Station, San Anselmo, California.

Bibl: State Mineralogist's Report XIV, p. 198; Bull. 38, p. 28.

## MANGANESE

*Black Diamond Mine* was in Sec. 14 and 23, T. 18 N., R. 7 W. A body of ore that was at first thought to be extensive yielded 100 tons of ore in 1917, and then pinched down to a narrow stringer. The ground is probably open to location at the present time.

Bibl: State Mineralogist's Report XIV, p. 198; Bull. 76, p. 32.

*Rattlesnake Manganese Mine* is located in the southeast quarter of Sec. 6, T. 18 N., R. 6 W., about two miles northwest of the Black Diamond. It was producing oxides of manganese from a lens four to six feet wide in red jasper beds in the year 1917. This section is now assessed to J. S. Brown (and others), Walnut Grove, Contra Costa County, California.

Bibl: State Division of Mines Bull. 76, p. 32.

No manganese is being produced in Glenn County at present.

## MARBLE

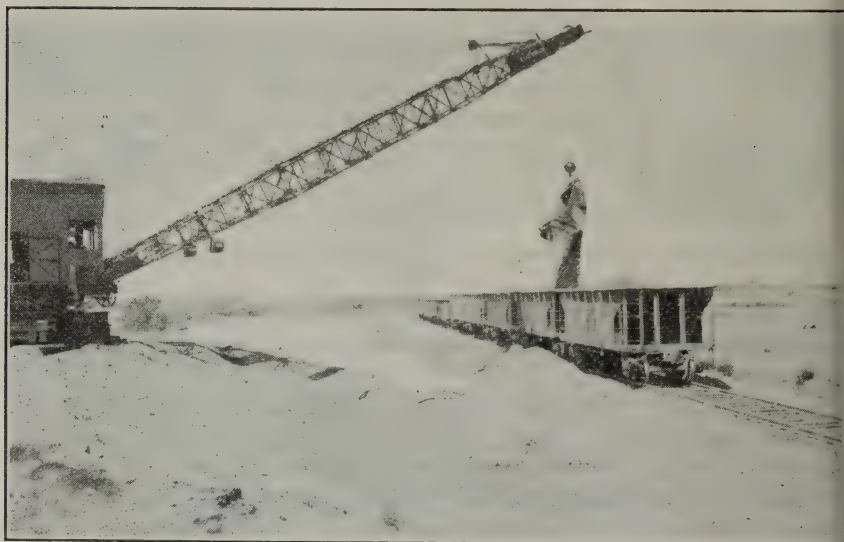
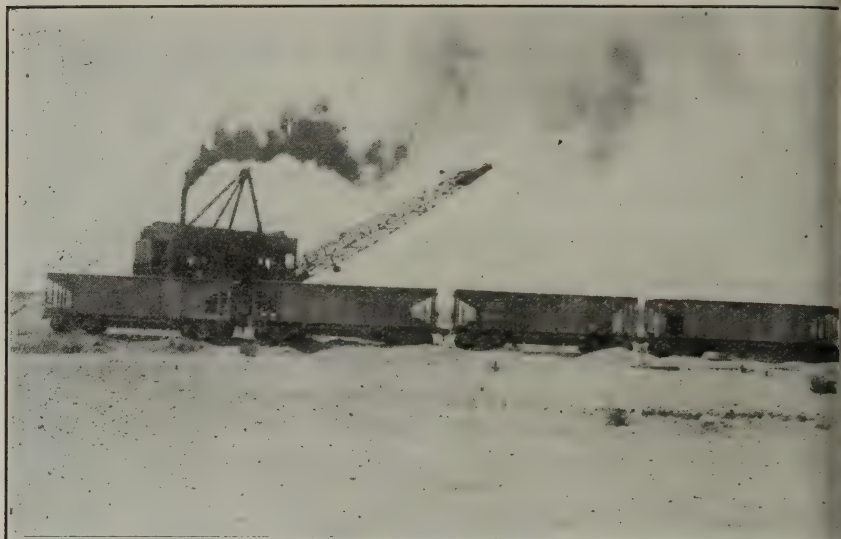
Undeveloped deposits of marble have been reported from the following locations:

*Brown Deposit.* Serpentine marble has been reported from the northwest corner of T. 18 N., R. 6 W., on land formerly owned by Alexander Brown. Several sections in this location are now assessed to J. S. Brown of Walnut Grove, Contra Costa County.

*Daniels Deposit.* White marble has been reported along the east side of Stony Creek in Sec. 21, T. 18 N., R. 6 W., formerly held by J. A. Daniels of Stonyford. The land in the location described is now assessed to Elizabeth J. Rogers, Fairmont Hotel, San Francisco.

*Nye Deposit.* Onyx marble has been reported from the J. M. Nye ranch, which is located in Sec. 1 and 12, T. 18 N., R. 8 W.

Bibl: State Mineralogist's Report XIV, p. 198.



Two views of the gravel pit of the Southern Pacific Railroad Company near Wyo, Glenn County.

## MINERAL WATER

*Alder Springs*, 40 miles northwest of Willows by road, are operated by Rube Hartman of Alder Springs post office.

*Salt Spring Valley*, four miles north of Stonyford, contains salt springs that are undeveloped.

Bibl: State Mineralogist's Report XIV, p. 199; U. S. Geol. Survey Water Supply Paper 338, pp. 299, 359.

## NATURAL GAS

Natural gas issues from an artesian well on the Rideout ranch near the Spaulding ranch, which faces the state highway, and is marked with a signboard at the entrance.

Bibl: State Mineralogist's Report XIV, p. 199; Bull. 3, p. 7.

## PETROLEUM

Bulletin 89 of this Division, 'Petroleum Resources of California,' includes a map of this region (Plate V), which indicates that a well was drilled about in Sec. 22, T. 20 N., R. 5 W. Section 22 is assessed to L. M. Garnett of Willows. According to Bulletin 89, Glenn County is not considered as a particularly favorable place to look for petroleum.

Bibl: State Mineralogist's Report XIV, p. 199; Bull. 89, p. 51.

## QUICKSILVER

Undeveloped cinnabar has been reported on the J. M. Nye ranch southwest of Fruto. H. M. Garnett of Willows is the present owner.

Bibl: State Mineralogist's Reports XII, p. 360; XIV, p. 199.

## STONE INDUSTRY.

*Glenn County Gravel Pits.* Gravel for road work was formerly produced by the county from pits in Sec. 24, T. 19 N., R. 3 W. and Sec. 16, T. 20 N., R. 3 W. Present production comes from a pit in Sec. 35, T. 20 N., R. 3 W. This pit is equipped with a 75-foot pole, on which is mounted a drag-line excavator. A 50-h.p. electric motor operates this; and gravel is screened and dumped into bunkers. At present the coarse material is rejected; but a crusher may be installed this season.

*Southern Pacific Railroad Company* owns a gravel pit on Stony Creek in Sec. 13, T. 22 N., R. 3 W., about two miles east of Wyo. Gravel is loaded directly into bottom-dump railroad cars with a 3-cu. yard Bucyrus drag-line excavator. The only washing that is done is accomplished by dragging the gravel from under water in a pond. The material is of a size and quality suitable for ballast with this cheap method of handling, and without sizing. Present production is at the rate of from 25 to 35 carloads per day; but the capacity is 60 carloads per day.

Bibl: State Mineralogist's Report XIV, p. 200.

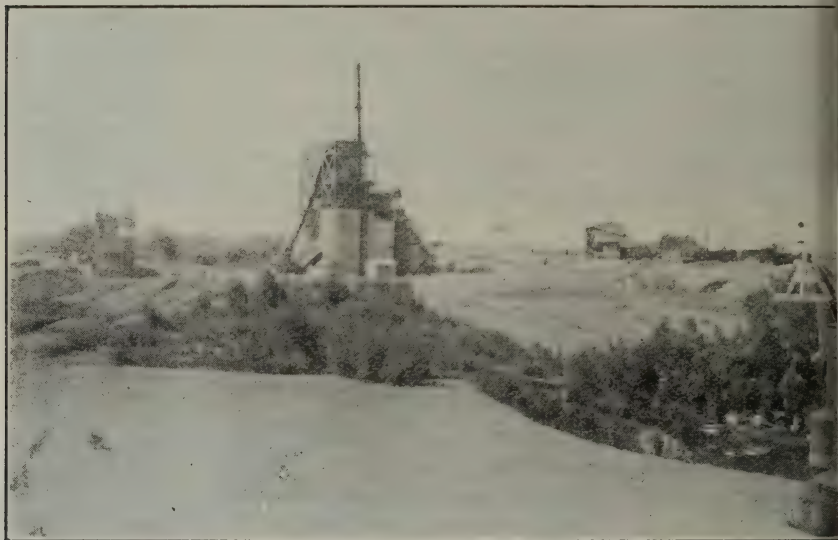
*Stony Creek Gravel Company* is operating a large plant for the production of gravel, sand and crushed rock in Sec. 15, T. 22 N., R.



3 W., at Wyo. The plant is on Stony Creek between the state highway and the Southern Pacific railroad. The present plant, with a capacity of 400 tons in 8 hours, was built five years ago. The owners are Herbert Twede and Howard Smith of Willows.

A mast on top of the bins supports one end of a slack-track cable on which the bucket of the drag-line excavator runs. The excavator equipped with a one-cubic yard bucket, is operated by means of double-drum Surman two-speed, 79-h.p. electric hoist. The track cable can be tightened or slacked with one drum of the hoist; and the bucket is pulled along this cable by means of a second cable attached to the second drum.

Primary crushing is done in a jaw crusher 14 by 20-inch; and secondary crushing in a Tel-smith crusher that takes about a 4-inch feed. These are driven by 35- and 40-h.p. motors respectively. Screening is done in 13 revolving screens to make the various products listed below.

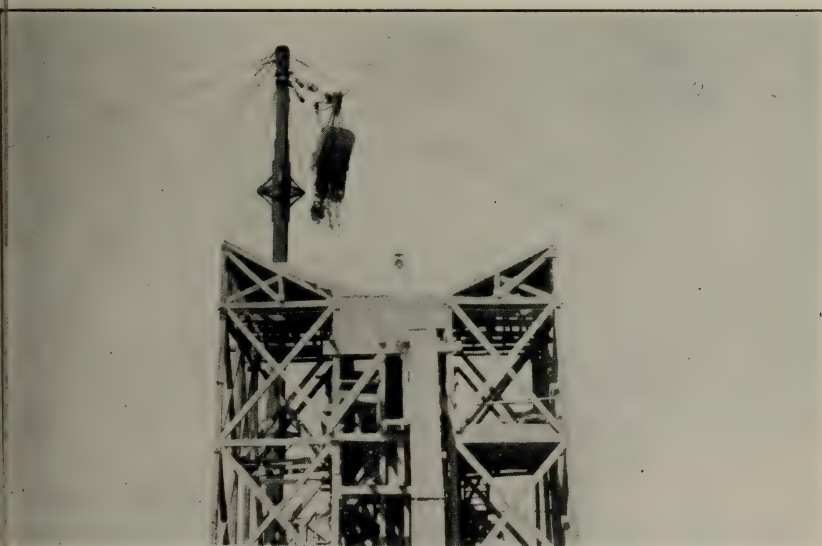


Plant of Stony Creek Gravel Company at Wyo, Glenn County.

These screens are in the form of truncated cones, about 4 feet in diameter at the large end and 5 feet long. All products are washed by means of an endless chain device that drags the material through water and up an inclined plane; while the silt runs to waste through an overflow. Water for this can be pumped either from a well or from the creek by means of a 5-inch centrifugal pressure pump with a 50-h.p. motor.

Products are stored in cylindrical concrete bins with walls 6 inches thick. Six of these are 20 feet in diameter and 30 feet high, the other two are the same diameter, but 35 feet high. Following are the sizes of products made, the three larger sizes being stocked in either washed rounded stream gravel or crushed rock:  $1\frac{1}{2}$  to  $\frac{3}{4}$  inch;  $\frac{3}{4}$  inch;  $\frac{3}{8}$  inch; bird's eye or  $\frac{1}{8}$  inch; plaster sand.

The last two sizes are mixed for concrete sand. The rock from the creek is largely limestone and basalt; and the flood waters usually



excavator loading and dumping, Stony Creek Gravel Company, Wyo, Glenn County.

refill the pit each winter. In delivering the products from the storage bins to the loading bin on a belt conveyor, the various sizes can be mixed in any proportion desired.

*Willows, City Pit.* The city of Willows formerly operated a pit for the production of gravel in Sec. 11, T. 19 N., R. 3 W., but at the present time uses the product of the county pit.

Bibl: State Mineralogist's Report XIV, p. 201.

*Sandstone* that could be utilized commercially has been reported from several points in the county, including the J. M. Nye ranch, now owned by H. M. Garnett of Willows.

Bibl: State Mineralogist's Report XIV, p. 201.



## SAN FRANCISCO FIELD DIVISION

C. McK. LAIZURE, Mining Engineer.

## ALAMEDA COUNTY

## Production.

Alameda County was organized under an act passed on March 25, 1853, its territory being taken from Contra Costa and Santa Clara counties. Since then only a few minor changes have been made in its boundaries and the two counties named now bound it on the north and south, respectively. San Joaquin County adjoins on the east. The shoreline of San Francisco Bay forms the boundary of its land area on the west, but the true line separating Alameda County from San Francisco and San Mateo counties lies within the navigable channel of the bay.

## Geography.

The county has a land area of 732 square miles (468,480 acres), of which 224,171 acres are farm lands, including pasture and woodland, and approximately 100,000 acres are tillable. Its population is 344,177 (1920 census), but estimated as 483,500, January, 1927. About 75% of its population is concentrated in the three principal cities on the continental side of San Francisco Bay, Oakland, Berkeley and Alameda. Oakland is the largest, having approximately 300,000 inhabitants and being the third city in size in the state.

The Southern Pacific railroad, Western Pacific railway, Atchison, Topeka and Santa Fe railway, all transcontinental lines, San Francisco and Sacramento railway and numerous ocean steamship lines provide excellent transportation facilities for raw and manufactured products. There are also many miles of paved highways extending to all but the most rugged portions of the county. Electric power is readily available. The rich bottom lands are devoted to intensive farming and fruit growing, a great variety of fruits and vegetables being produced. Raising and stock raising are also important sources of wealth. Although not classified as a 'mining' county, Alameda produces a variety of minerals, ranking first in the state in production of salt, and having a total annual mineral output valued at \$2,500,000 to \$3,000,000. The county is the home of many large industries, including ship building, canning and preserving, lumber mills, foundries and machine shops, printing establishments, chemical works and ceramic plants.

## Topography and Geology.

Several ranges forming the eastern group of the Coast Range Mountains traverse the county in a northwesterly direction. These ranges become more rugged and reach higher altitudes in the southeastern portion of the county. In this latter area the formations are mainly Franciscan metamorphic sandstones, jaspers and serpentine, and it is here that the magnesite, manganese and chromite deposits occur. This region is accessible only by graveled and dirt roads. Cretaceous and

## MINERAL PRODUCTION

Year	Brick		Chromite		Pottery clay		Coal		Manganese	
	M	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
1890			1397	\$534					1	
1891			257	344						
1892										
1893										
1894	7,500	\$37,500							468	
1895	12,000	60,000							600	
1896	7,000	35,000							318	
1897	6,500	35,750					21,900	\$50,370	504	
1898	7,000	35,000					70,500	176,250	440	
1899	10,000	60,000					80,703	242,109	290	
1900	5,000	40,000					91,731	332,066	130	
1901	9,590	67,130					87,424	262,272	423	
1902	10,000	60,000					67,850	203,550	870	
1903	10,300	82,400					"			
1904	10,500	90,000					"		60	
1905	12,000	95,500								
1906	21,345	413,750			10,000	\$10,000				
1907	28,770	474,350			12,610	14,299				
1908	1,800	10,800	70	595	16,370	44,822			260	
1909	14,800	140,000	"		45,348	205,194				
1910	20,919	195,889	69	552	9,541	63,925				
1911	19,660	153,330	60	500	10,500	8,300				
1912	12,800	133,100							20	
1913	13,977	122,937			3,000	2,700				
1914	22,668	159,205			5,000	1,000				
1915	14,841	132,765							319	
1916	23,551	315,941	612	7,344	4,060	2,750			562	
1917	and tile	290,033	52	960	6,502	4,524			1,211	
1918		258,812	220	14,600	2,675	3,850			2,746	1
1919		369,778	80	1,264	5,011	12,127			"	
1920		664,918			3,001	3,762			"	
1921		365,853			6,079	7,405			"	
1922		"			"				130	
1923		828,048			2,850	10,422				
1924		763,476			2,482	1,124				
1925		938,375			9,300	11,376				
1926		808,779			5,870	7,183				
1927		587,402			6,593	20,516				
1928		505,386			27,189	17,071				
Totals		\$9,331,207	\$1,817	\$26,693	193,981	\$452,350	\$420,108	\$1,266,617	9,351	\$1

<sup>1</sup>There was some production of chromite, manganese and salt in Alameda County in the years previous to those here but the separate county figures are not available.

<sup>2</sup>Includes crushed rock, macadam, ballast, rubble, rip-rap, sand, gravel.

<sup>3</sup>See under 'Unapportioned.'

## MEDA COUNTY, 1890-1928.

Pyrites		Salt		Miscellaneous stone, <sup>2</sup> value	Miscellaneous and unapportioned		
ns	Value	Tons	Value		Amount	Value	Substance
		1					
		44,450	\$125,425	\$73,463	1,265 cu. ft.	\$1,000	Building stone
		43,810	114,575	94,372	500 cu. ft.	300	Sandstone.
		55,826	122,810	69,405			
		61,353	139,830	73,300			
		87,800	155,812	73,845	2,000 cu. ft.	750	Sandstone.
		78,434	137,088	66,512			
		64,718	158,674	107,551	30 tons	180	Magnesite.
500	\$18,000	114,450	324,136	107,201	13,728 lbs.	2,162	Copper.
					190 tons	1,100	Magnesite.
					1,500 lbs.	52	Lead.
					100 tons	500	Magnesite.
					10,000 tons	15,000	Lime.
					500 tons	1,750	Glass sand.
					1,416 tons	14,400	Asphalt.
					11,943 tons	143,376	Asphalt.
					3 tons	48	Soapstone.
					250 tons	625	Glass sand.
					18,290 tons	241,475	Asphalt.
						233,032	Unapportioned, 1900-09, inclusive.
					18,290 tons	197,783	Asphalt.
					40 tons	260	Soapstone.
					5,000 bbls.	5,000	Lime.
					50 tons	250	Limestone.
					150 tons	1,500	Magnesite.
					10 tons	20	Limestone
						1,740	Asbestos, chromite, pottery clay.
						26,657	Limestone, magnesium chloride, magnesite.
		148,846	315,970	413,845		83,141	Lime, limestone, magnesite, magnesium salts, potash, pyrites.
						19,169	Asbestos, magnesium salts, potash, limestone.
						16,864	Magnesium salts, manganese, potash.
						28,354	Magnesium salts, manganese, mineral paint, potash.
						25,826	Magnesium salts, manganese, mineral paint, potash.
						845,936	Brick, hollow building tile, magnesium, salt, pyrite.
						97,515	Magnesium salts, pyrite.
						75,506	Magnesium salts, potash, pyrite.
						54,665	Magnesium salts, potash, pyrite.
						71,414	Bromine, magnesium salts, pyrite.
						65,506	Magnesium salts, potash, pyrite.
						20,330	Pyrite, travertine.
3,697	\$1,005,527	3,952,810	\$10,018,686	\$17,444,559		\$2,293,186	



Tertiary sandstones and shales with unconsolidated Quaternary sand gravels and clays forming the low lands adjacent to the bay shore, the other important areal formations. A detailed study of topography and geology of the western portion of the county, with maps, is contained in U. S. Geological Survey Geologic Folio 193 (San Francisco Quadrangle), and topographic maps of the entire county are available.

Alameda Creek, Arroyo del Valle, Arroyo Mochó and their tributaries flowing generally northerly and westerly into San Francisco Bay form the principal drainage system of the county.

### MINERAL RESOURCES

The table herewith shows the total recorded mineral output from 1848 to 1928, inclusive. This total of \$42,034,420 covers 38 years only. The present annual value of output, and the variety of commercial mineral products shown may be noted with some surprise, as Alameda County usually is not classed as a mining area. No segregated county figures are available prior to 1890, but as the production of salt began here in the fifties and manganese, chromite, and coal were all produced before 1890, the total is even larger than that recorded.

The most important mineral products in point of total value have been miscellaneous stone, crushed rock, sand and gravel, salt, brick, coal, pyrite, pottery clay, manganese and chromite; with magnesite, limestone, asbestos, magnesium salts and small amounts of various other nonmetallics and metals making up the balance. The output in 1928 was valued at \$2,421,830, this county ranking fifteenth among the counties of the state in value of mineral production. The products were miscellaneous stone, salt, brick and hollow building tile, pottery clay, pyrite and travertine.

The last general report upon the county was published in State Mineralogist's Report XVII, 1920. Manganese and chromite deposits were described in Bulletin No. 76, 1918; magnesite deposits in Bulletin No. 79, 1925; the clay deposits in Bulletin No. 99, 1928; all of which are still available for distribution. In this report emphasis is placed on present activities and such developments as have occurred since the above publications were issued.

#### ASBESTOS

A few tons of asbestos were mined on the hills east of Fruitvale close to the Contra Costa county line, in 1915, by the John D. Hoff Asbestos Company, of Oakland. The fibre was short and the occurrence was limited that no further production has been made. It was ground and used with magnesite in the manufacture of fireproof tile at their plant.

#### BRICK AND CLAY

The clay deposits and ceramic plants in Alameda County were described in detail by Dietrich<sup>1</sup> in 1928. Except for the Ryan Ramo and the new Copeland development, there has been little or no change of status, and the descriptions in Bulletin 99 will suffice. The following companies are operating in the county:

<sup>1</sup> Dietrich, W. F., "The Clay Resources and Ceramic Industry of California," Division of Mines Bulletin No. 99, 1928.

*California Bisque Doll Co.* (formerly California China Co.), 1175 San Pablo Ave., Berkeley, Cal.

*California Faience Co.* (formerly The Tile Shop), 1335 Hearst Ave., Berkeley, Cal.

*California Pottery Co.* Plants at 2265 E. 12th St., Oakland, and at Merced, Merced County.

*N. Clark & Sons*, 112-116 Natoma St., San Francisco, Cal. Plant at Pacific Ave. and Fourth St., Alameda, Cal.

*Copeland Clay Deposit.* A deposit of clay on the Truman Copeland property in the NW $\frac{1}{4}$  of Sec. 27, T. 3 E., R. 3 S., has been under development the past two years by *Ka-Ola Fire Clay Company*, stated to be a Nevada corporation with office in Reno. Wilfred Dennis of



Kiln and tunnel at Copeland Clay Deposit of Ka-Ola Fire Clay Co., Alameda County.

Berkeley is named as one of the principals. A tunnel has been driven into the hill about 300 feet which cut a flat-lying bed of fire clay similar to that on the Ryan Ranch. A small vein of coal was also cut and the face of the tunnel is in a heavy bed of dark-colored clay. Near the opposite side of the hill and higher up there is another tunnel about 100 feet in length driven to develop water. A small experimental kiln has been built. All of the burned brick lying around are of a reddish color. No one was found at the property when visited.

*W. S. Dickey Clay Manufacturing Co.*, 604 Mission St., San Francisco. Plants at Niles and Livermore.

*Electrical Porcelain Works*, 2414-16 Sixth St., Berkeley, Cal.

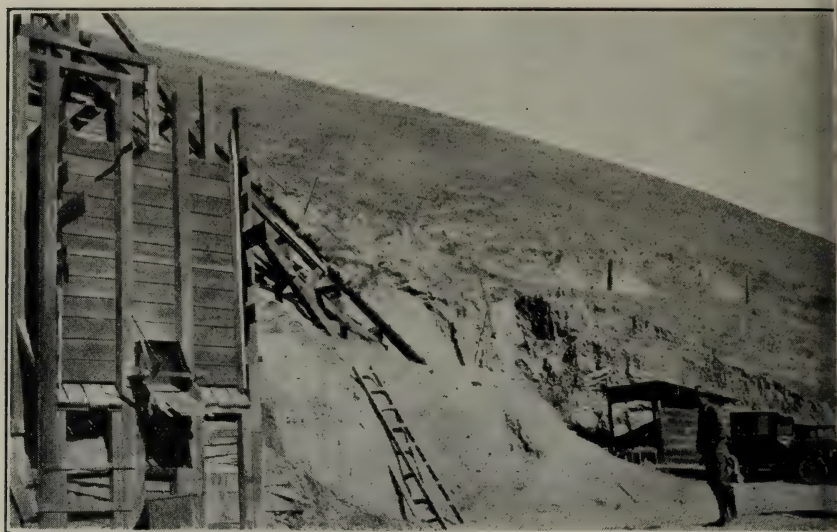
*Hidecker Tile Co.* Plant at Twenty-fourth and Union Sts., Oakland, Cal.

*Kraft Tile Co.*, 55 New Montgomery St., San Francisco, Cal. Plant at Pabrico, 2 miles west of Niles.

*Miller's Oakland Art Pottery*, 2237 East Twelfth St., Oakland, Cal.  
*M. and S. Tile Co.* Plant is near Decoto on Oakland-Niles highway  
*Muresque Tiles, Inc.*, 1001 Twenty-second Ave., Oakland, Cal.

*Remillard Brick Co.*, 332 Phelan Bldg., San Francisco, Cal. Plant one and one-half miles northeast of Pleasanton.

*Ryan Ranch Clay Deposit.* This deposit was taken over in April 1929, by *Alameda Clay Corporation*; J. K. Brasier, president, 333 First National Bldg., Oakland. An incline shaft (62°) has been put down 160 feet on the dip of the clay bed. This bed was 5 feet thick at the surface. The clay disappeared in the shaft at a shallow depth and for 100 feet there was no clay in sight, but at that depth a small fault was encountered and the shaft again entered a 5-foot bed of fire clay. The



Ryan Ranch Clay Deposit of Alameda Clay Corporation, Alameda County.

mine is lighted by electricity, but a gasoline hoist mounted on a tractor is used in mining. The clay is hauled by trucks to a plant near Livermore, which is taking the entire output.

*Technical Porcelain and Chinaware Co.*, 420 Kains Ave., Albany, Cal.  
*Tesla Clay Deposits*, Corral Hollow, near Tesla, Cal.

*Walrich Pottery*, 1285 Hearst Ave., Berkeley, Cal.

*Westinghouse Electric and Manufacturing Co.*, 6121 Green St. Emeryville, Cal.

*Woolenius Tiles*, 1631 Woolsey St., Berkeley, Cal.

Bibl: (Clay Resources of Alameda County): State Mineralogist's Reports X, p. 91; XII, p. 39; XIII, p. 51; XIV, p. 607. Bulletins No. 38, pp. 202, 204-206 and 227; No. 99, pp. 38-49. Preliminary Report No. 7, pp. 35-37, 94. U. S. Geol. Survey 22d Annual Report, Pt. III, pp. 501-504.



## CHROMITE

All the important deposits of chromite are found on Cedar Mountain in the southeastern part of the county. They were first mined years ago and had produced approximately 6500 tons up to time of the break in the market at the end of 1918. None are active at present.

*Clarke Claim* in Sec. 26, T. 4 S., R. 3 E.

*Newman Mine*, formerly Mendenhall Mine, in Sec. 26, T. 4 S., R. 3 E. Owner, S. V. Newman, Livermore.

Bibl: (Chromite) State Mineralogist's Reports VII, p. 36; XII, p. 48; XIII, p. 48; XVII, pp. 20-21; Bulletins No. 38, p. 267; No. 76, p. 115-116; U. S. Geol. Survey Bull. 430, pp. 173-174.

## COAL

Coal was discovered in Corral Hollow in 1862, and shortly afterwards a few mines were opened up. However, only a comparatively small production was made until 1897. Between 1897 and 1902 the output reached 90,000 tons annually. Mining operations ceased entirely in 1902, because of the inferior quality of the coal, which made its competition with outside coal impossible, as well as the high cost of extraction due to the steep dip and faulted nature of the beds.

Beckman-Linden Corporation of San Francisco purchased the Tesla property in June, 1919, and began the erection of building and equipment for the production of powdered coal which was to be used as fuel for the production of electric power at the property. A considerable sum of money was expended on development before it was clearly demonstrated that commercial success could not be expected under prevailing conditions.

Bibl: (Coal in Alameda County) State Mineralogist's Reports IV, p. 269; VII, pp. 146, 173; VIII, pp. 26, 29; IX, p. 323; X, p. 91; XII, p. 39; XIII, p. 51; XVII, p. 21; Bulletin 99, p. 42; U. S. Geol. Survey, 22d Annual Report, Part III, pp. 501-504; Bulletins 585, p. 28; 603, p. 209; U. S. Bur. of Mines Bulletin 22, pp. 53, 395.

## COPPER

(See Pyrite.)

## LIMESTONE AND MARL

*McLaughlin Lithographic Stone Quarry*<sup>1</sup> is in the SW $\frac{1}{4}$  of the SW $\frac{1}{4}$  of section 35, T. 1 S., R. 2 W., M. D. B. and M., close to the Contra Costa county line. The property consists of 8 acres. The stone from the croppings is found to be quite hard, but not homogenous, as it contains silica in quantities sufficient to be a detriment for lithographic work. The croppings, which are about 570 feet in length, run slightly south of east and north of west and dip southerly 75 degrees. The walls are of sandstone and conglomerate.

The vein is about 5 feet thick and has been opened by a 30' open cut which was made about 1905 by J. Ramage. This cut has uncovered

<sup>1</sup> From an unpublished report by W. W. Bradley.

the vein for a distance of about 25 feet along the strike and 20 feet high. Considerable stone from this cut is to be seen on the dump.

That part of the vein that has been exposed to the elements seems to have been hardened and bleached and is very light gray in color. The stone seems to have some very small fractures, but they are not harmful. The stone that is available at the present time has some of the properties of a good lithographic stone, such as taking grease, and ink, and being acted upon by acids, but it has not quite the fineness and uniformity of grain required for engraving work. As is shown, however, by the results of a practical test made by Schmidt Lithographic Company, it could be used for 'penning,' that is, for painting the design upon the surface of the stone instead of cutting the design into the stone. The character of the stone in depth can only be determined by doing development work. The property is idle.

*Mission Lime Marl Deposit.* This deposit is situated about one-quarter mile east of Mission San Jose. The property is under lease to T. D. Witherly, Box 52, Mission San Jose. The limestone, which is somewhat soft and decomposed, outcrops at the base of a small hill easily reached by good road. Mining is by open cut. The material is suitable for agricultural use, but the production to date has been small. It was equipped with a grizzly, small jaw crusher, Grundt mill, bucket elevator and bin, but most of this has been removed. An analysis of the material, as reported by the Pacific Chemical Laboratories, was as follows:

Nitrogen -----	0.46%
Limestone -----	83.10%
Lime phosphate -----	0.59%
Potash (soluble) -----	0.46%
Undetermined -----	15.39%

Similar material is said to occur at other points on the Witherly property, but no development has been done at these localities.

*Pleasanton Lime and Cement Co.* This company had a lease on a limestone deposit situated half way between Sunol and Pleasanton on the Western Pacific Railroad. A little lime has been occasionally burned here in 2 patent kilns equipped with oil burners and sold for fertilizing purposes.

Bibl: (Limestone in Alameda County) State Mineralogist Reports VIII, pp. 35, 104; XIII, p. 627; XVII, pp. 22, 23; XX, p. 184. Bulletin 38, p. 64.

#### MAGNESITE

Magnesite was mined in Alameda County as early as 1886,<sup>1</sup> the deposit being located on Cedar Mountain about 13 miles southeast of Livermore. The magnesite occurs in a decomposed serpentine rock and in a yellow clay in which are imbedded large boulders. It lies in pockets and small veins, the latter running in all directions. Several of the deposits have been exhausted and only one property was worked to any material extent. Magnesite croppings and considerable flows have been found in Rocky Ridge, west of Cedar Mountain and separate from it by the Arroyo del Valle, but no large deposits have yet been uncovered.

<sup>1</sup> U. S. Geol. Survey, Min. Res. of the U. S., 1886, pp. 6, 696.

*Cedar Mountain Magnesite Mine* is in Sec. 27, T. 4 S., R. 3 E., M. D. M., at an elevation of 3250 feet above sea level. It was worked spasmodically for several years, and in 1917 and 1918 was being operated under a ten-year lease by J. W. Clark and D. M. McDonald of Livermore.

Over 2000 tons of magnesite were shipped from this deposit in 1916, and about 1160 tons sold to the Hoff Asbestos Company, Oakland, in 1917. This latter brought from \$12 to \$14 per ton. Very little work has been done since 1917. The magnesite from this deposit is, as a rule, of excellent quality. The area of the holdings is 160 acres. M. I. Locker, 1023 Insurance Exchange Bldg., San Francisco, owner. Idle.

*Hays Ranch Deposit.* Some small croppings of buff-colored magnesite occur in the SW $\frac{1}{4}$  of Sec. 24, T. 4 S., R. 2 E., M. D. M., about 11 miles southeast of Livermore near the summit of Rocky Ridge. Some large boulders of pure-white float are lying in a ravine north of and below the outcrop. Several tunnels were driven into the hill under these boulders in hopes of striking an orebody, but none was encountered. On the east slope of the ridge numerous boulders have been found. Cuts have been made along the slope at several places, in all of which boulders of high-grade ore have been found. It is possible that these boulders are in place, being formed as a gradual replacement of serpentine; however, considerable development would be necessary to determine this. About 25 tons of magnesite are lying on the dumps. There has been no rock shipped from this prospect and it is idle. An old wagon road from Livermore gives easy access to the property.

*Winship Properties.* K. D. Winship, 350 Post Street, San Francisco, owner. J. W. Clark and D. McDonald of Livermore, as lessees, in 1917 did some prospecting and development work on a series of magnesite outcrops on this property in Sec. 25, T. 4 S., R. 3 E., about one mile east of the Cedar Mountain mine.

In the SW $\frac{1}{4}$  of Sec. 35, something over a mile southwest from the above, there is a considerable body of serpentine which extends westward at least as far as the center of Sec. 34 adjoining. In this area, near the north-central part of the SW $\frac{1}{4}$  of Sec. 35, there is a small but promising looking outcrop of magnesite. In the serpentine area there are also patches of pellets and occasional veinlets of hydro-magnesite (a soft hydrous carbonate of magnesia). Some of the larger of these patches were at one time worked at the 'magnesia mine' in Sec. 34. As these sections lie in a rather deep canyon, a branch of the Arroyo del Valle, transportation out would be difficult and expensive.

Bibl: (Magnesite in Alameda County) State Mineralogist's Report XVII, pp. 23-24; Bulletin No. 79, pp. 41-43. U. S. Geol. Survey Bull. 430, p. 173.

#### MANGANESE

Deposits of manganese ore occur southeast of Livermore mainly in and adjacent to T. 4 S., R. 3 E. Franciscan sandstones, serpentine, chert and jasper predominate in this area. Most of the orebodies are associated with the chert and jasper beds. The deposits vary greatly in strike, dip, size and grade of ore. Much of the ore is low grade and siliceous. A few of the deposits were worked in the seventies and



some intermittent mining has been done since. In 1917 and 1918 under the stimulus of war conditions considerable ore was shipped from this county and several new deposits were opened up. The last reported production was in 1922, since which time there has been active mining. The total output has been about 10,000 tons.

The following properties have been described in former reports and bulletins still in stock, and they will be mentioned only briefly.

*Berendiere Mine.* In Sec. 14, T. 4 S., R. 3 E., 12 miles southeast of Livermore. The ore is a porous black oxide associated with jasper and shale of the Franciscan series. Has produced some good ore.

*Black Jack Mine.* In the same section as the Berendiere. A carload or two of ore has been shipped from this property. H. T. Overack, Livermore, owner.

*Buckhorn Claim.* In Sec. 31, T. 4 S., R. 3 E. Some high-grade ore was exposed here and a few tons shipped in 1917.

*Camp No. 9 (Merchant Mine).* This mine is in the NW $\frac{1}{4}$  of Sec. 11, T. 4 S., R. 3 E. It was opened up in 1888 and has been worked intermittently since. Over 1000 tons of ore were shipped between 1916 and the first part of 1918. The ore consists of both black oxide and the steely gray carbonate rhodochrosite. This is the only occurrence of rhodochrosite noted in the county. M. T. Crocker, 354 Pine St., San Francisco, owner.

*Crosby Prospects* are situated one-half mile from the Crosby Ranch in the SE $\frac{1}{4}$  SW $\frac{1}{4}$  Sec. 30, T. 4 S., R. 3 E. The ore on the surface is siliceous, but there is a possibility of developing some good ore here.

*Dewhurst Mine.* In NE $\frac{1}{4}$  SW $\frac{1}{4}$  Sec. 22, T. 4 S., R. 3 E. Some ore was shipped from here in 1917-1918 which ran 34% manganese and high in silica.

*Elliott & Searles Deposit.* This was opened up in 1917 and several hundred tons of ore shipped. It is on or near Sec. 7, T. 5 S., R. 4 E. 20 miles southeast of Livermore.

*Ellis Ranch Deposit.* Situated on the Ellis Ranch 8 miles southeast of Livermore on the Tesla Road, in Sec. 28, T. 3 S., R. 3 E. First discovered about 40 years ago. A little ore running 42% or 43% manganese was shipped when last active in 1918.

*Frigger Prospect* is near the Dewhurst Mine in NW $\frac{1}{4}$  Sec. 22, T. 4 S., R. 3 E. Siliceous manganese oxide appears on the surface as float but no commercial ore has been developed to date.

*Kelly Ranch Deposit.* Two bodies of massive oxide ore up to 7 feet in width occur on the Kelly Ranch in Sec. 5, T. 4 S., R. 3 E., 8 miles southeast of Livermore. There are 3000 to 4000 tons of ore said to be blocked out, but it is low-grade and siliceous.

*Newhall Manganese Lease (Bailey Mine)* is in SW $\frac{1}{4}$  NW $\frac{1}{4}$  Sec. 11, T. 4 S., R. 3 E. Several hundred tons of ore have been shipped from this property.

*Newman Manganese Mine (Estacia or Fratis Mine)* is in Sec. 22, T. 4 S., R. 3 E. This deposit has been worked at long intervals in

all way since 1880. Lessee took out a small tonnage of 49% ore in 17-1918.

*Reay Deposit* is in Sec. 36, T. 3 S., R. 3 E. There are several outcrops of chert mixed with black oxides of manganese near the line between sections 35 and 36. They are undeveloped.

*Root Claim.* Several carloads of manganese ore were shipped from this claim in the first part of 1918. The claim was on Man Ridge in either Sec. 7 or 18, T. 5 S., R. 4 E.

*Scott and Winegar Mine* (Man Ridge Mine) comprised two claims about 20 miles southeast of Livermore near the summit of Man Ridge in Sec. 7, T. 5 S., R. 4 E. In the spring of 1917 the Noble Electric Steel Co. produced 600 tons of ore from this property.

*Standard Magnesite Co.* owned a deposit on Man Ridge in Sec. 7, T. 5 S., R. 4 E., from which there was a considerable output in 1918.

*Winegar Manganese Mine* is in Sec. 4, T. 5 S., R. 4 E. Very little work has been done on this property.

*Winship Properties.* K. D. Winship Estate, owner, 350 Post Street, San Francisco. In Alameda County these holdings included the following sections which have manganese prospects or developed deposits. Sec. 35, T. 3 S., R. 3 E.; Secs. 1 and 3, T. 4 S., R. 3 E.; Sec. 31, T. 3 S., R. 4 E.; Sec. 7, T. 4 S., R. 4 E.; Sec. 7, T. 5 S., R. 4 E. A body of good ore six feet in width was opened up on Sec. 31, T. 3 S., R. 4 E., by leases in December, 1917.

Bibl: (Manganese in Alameda County) State Mineralogist's Report XVII, pp. 24-28; Bulletin No. 76, pp. 24-29.

#### MINERAL PAINT

*McLean Red Shale Deposit.* A red cherty shale outcrops in several places on the old John Berendiere property 12 miles southeast of Livermore in Sec. 14, T. 4 S., R. 3 E. The rock, which is dark red and of fairly uniform color and quality, has been tested at various times for making paint, but never used for that purpose. W. S. McLean, 19 San Bruno Road, San Francisco, has a lease on 160 acres and has been operating a quarry for the past eight years. The shale is hauled by truck to Livermore and then shipped by rail to McLean's mill in San Francisco, where it is used in making red roofing granules. At present about 10 cars per month are being shipped.

Bibl: State Mineralogist's Report XVII, p. 28, Roofing Rock.

#### MINERAL WATER

Although there has been no commercial production of mineral water in Alameda County, there are several groups of mineral springs, the waters of which are mostly used for domestic purposes. At the largest of these, Piedmont Springs, a recreation park has been conducted for a number of years. The following descriptions of the Alameda County springs are quoted from Gerald A. Waring,<sup>1</sup> who made an exhaustive report on the springs of California.

<sup>1</sup>U. S. Geol. Survey Water Supply Paper 338, 1915.

"*Mayhew Spring* is about 200 yards north of Niles depot. It is situated in an orange orchard and is surrounded by a cement stone curbing which forms a reservoir about 4 feet in diameter and 10 feet deep. A small pipe and faucet furnish an outlet from a point about 3 feet below the surface, but the yield is only about 1 gallon a minute of water that had an observed temperature of 67° in the reservoir.

"The spring was known to the Spaniards in the early days and is still used to slight extent for drinking. Bubbles of gas continually rise in the reservoir, but the water is only faintly sulphuretted. The spring is situated on a gentle alluvial slope at the mouth of a drainage wash between hills of sedimentary rocks that are probably of Tertiary age.

"*Mendenhall Springs* are 11 miles by road southeast of Livermore on the steep southwestern side of the canon of Arroyo Mocho, 500 feet above the stream. Two springs here seep from short prospect tunnels 50 yards apart that were driven many years ago in search of gold. The water was early noticed to be perceptibly mineralized, the perceptible taste apparently being due to magnesia, and a number of years ago it was bottled as Aqua de Vida (Water of Life) Springs Water.

"The water of the southern spring is piped to a tank and furnishes a domestic supply; the other spring supplies a watering trough in the barnyard. Their flows are respectively one gallon and half a gallon a minute.

"The water is apparently of surface origin and has become somewhat mineralized from the materials through which it percolates. The tunnels are driven into thin-bedded cherts and crushed shales that belong to the Franciscan group.

"The property was improved as a mountain resort. In 1909 accommodations for 75 people were provided by several cottages and by a dining room in the main building. It has not been in operation as a resort for a number of years (June, 1919).

"*Piedmont Springs* are in a recreation park on the hillside 3 miles north of Oakland.

"Two mineralized springs, which are known, respectively, as Sulphur and Magnesia springs, rise in a ravine that extends through the property. The springs have been curbed and covered, and the ravine has been graded for a walk. The waters are piped about 100 yards downstream into two drinking basins in a grotto-like spring house that is built against a rock face at the side of the ravine. A third basin in the spring house is supplied from the municipal water main. The water of both springs is noticeably sulphuretted, and that of the magnesia spring also tastes distinctly alkaline. Both have noteworthy primary salinity and secondary alkalinity, but although the sulphur spring is characterized by secondary salinity, the magnesia spring has high primary salinity.

"*Sweet Springs*, another group of magnesian springs that are associated with serpentinite rock, rise at the border of a small meadow on a low saddle between two ravines 18 miles southeast of Livermore. The group, which is known as Sweet Springs, includes 10 that issue for a space of 200 yards along the southeastern side of the meadow and 4 others that issue on its eastern side. They range in size from mere seepages to flows of 6 or 8 gallons a minute, the total yield being



perhaps 30 gallons a minute. The water has a distinctly sweet taste. The locality has been used by range stock as a watering place.

The principal springs rise from the northern border of an area of pyroxene rock and serpentine which cover the slopes to the south, the slopes north of the springs being of siliceous sandstone. The sandstone probably belongs to the Franciscan group of altered sediments, which occupies considerable areas in the coast ranges, and the serpentine bears its usual intrusive relation to the sediments.

*Warm Springs.* Four warm springs that issue on a hillside bordering the lowland at the southeast end of San Francisco Bay have given the small town of Warm Springs its name. They are situated about 2 miles northeast of the town, within the private grounds of Mr. Joseph W. Stanford. One of the springs rises in the lawn adjacent to Mr. Stanford's residence. It has been inclosed to form a covered reservoir about 12 feet square, which furnishes part of the domestic supply and yields perhaps 5 gallons a minute. Two other springs rise beside a walk a few yards away, in open basins from which there are flows of approximately 1 and 4 gallons. The larger of these springs is a temperature of  $86^{\circ}$ . The fourth spring is 200 yards southward, on a little swale on the southern side of a knoll. It yields perhaps 5 gallons a minute, of water  $90^{\circ}$  in temperature, which is collected in a small covered reservoir and piped to the grounds for domestic and garden use.

"The water of all the springs is faintly sulphuretted and is considered to be somewhat mineralized by sodium salts. Sandstone, gravel and some calcareous material form the hill slopes here."

Bibl: (Mineral Water in Alameda County) State Mineralogist's Report XVII, pp. 28-32. Anderson, Winslow, Mineral Springs and Health Resorts of California, p. 223, 1892. U. S. Geol. Survey Water Supply Paper No. 338.

#### MOLDING SAND

Deposits of light molding sand are found along Alameda Creek about 5 miles west of Decoto. The material is a mixture of fine sand and clay deposited by the creek during the winter and spring rainy seasons. Production has been made in the past from the property of *George Small*, but this is no longer active.

*Langdon Bros.*, R. F. D. Box 89, Niles, California, own land along the creek adjoining Small's and annually dig and ship a number of cars. It is used for light castings. The business is incidental to farming operations.

#### PYRITE

With the exception of Shasta County, which has been the largest producer, Alameda is the only other county that has made a regular production of pyrite over a period of years. The Alameda deposits occur in a narrow belt of rhyolite lava that extends more or less continuously along the west front of the hills bordering the bay from Berkeley nearly to Decoto.

The deposits that have been developed are near Leona Heights about four miles southeast of the Oakland city hall where the rhyolite formation has a maximum width of one and one-half miles.

The pyrite occurs as rather massive bodies of irregular shape, having in some places sharply defined and in others vaguely defined boundaries. In discussing the origin of these deposits Lawson<sup>1</sup> states:

"The ore has practically no gangue but contains here and there small horse country rock. It consists of pyrite mixed with chalcopyrite and pyrrhotite and little silica. It also contains very small quantities of gold and silver. Some native copper has also been found in older workings, and the mine water is charged with copper sulphate.

"The deposits are metasomatic replacements of the rhyolite, formed at a time when the ground water stood higher with reference to the ore bodies than it does at present. The retreat of the ground water to lower levels, owing to the deformation and dissection of the region, has led to the partial oxidation of some of these deposits and the consequent production of goossans of hematite and limonite. The oxidation of the sulphides has given rise to other secondary minerals, of which melanterite, pisanite, boothite, chalcantite, copiapite, epsomite, and alunogen have been described by Schaller.

"It is worthy of note that these pyritic deposits are confined to the rhyolite and that the unoxidized rock contains minute crystals of pyrite, which are rather thick but sporadically scattered through it, and also that the rhyolite is the only rock in the district containing disseminated pyrite crystals. A sample of the unoxidized rhyolite charged with pyrite was assayed and found to contain gold to the value of 16 cents to the ton.

"It is probable not only that the ore replaced the rhyolite but that the material that were originally disseminated through the rock have been concentrated during the process of replacement. The rhyolite has been decomposed by sulphuric acid produced by the oxidation of the disseminated pyrite near the surface of the rhyolite. The formation was originally much thicker than it is now, and as the surface was gradually lowered by erosion the process has been continuous. Theoretically, on result of the process, besides the chemical attack on the silicates, should be that, as the available oxygen became exhausted near the surface, the ferrous sulphate would descend to lower parts of the formation and be reduced in the ground water to sulphide. The course of these descending solutions and the sites favorable to the precipitation of the sulphides on reduction would be determined by the rock structure. The deposits are very similar in their essential features to larger and more cupriferous deposits in similar rocks elsewhere, many of which have been explained as the result of ascending magmatic water. The genesis of the deposits at Leona Heights, however, is apparently simpler; they may be ascribed to the action of ordinary meteoric waters. Other similar deposits of pyrite will probably be found in the body of the Leona rhyolite."

Bibl: State Mineralogist's Report XVII, pp. 32-33; Bulletin No. 50, pp. 169-170; No. 38, p. 349. U. S. Geol. Survey, San Francisco Folio No. 193.

*Alma Mine.* This property which was opened up in 1892 is owned by the *Stauffer Chemical Company*, 624 California St., San Francisco. It was worked with little interruption until 1921 since which time it has been idle. There are more than 5000 feet of tunnels and drifts. The owners state that the shut down is probably permanent.

Bibl: State Mineralogist's Report XVII, p. 33; Bulletin No. 50, p. 170; No. 38, p. 349.

*Leona Heights Mine.* Situated about one mile south of the Alma Mine on lands of the Realty Syndicate Company of Oakland. The mine proper is operated by *Leona Chemical Company*, Syndicate Building, Oakland; D. A. McDonell, president and general manager. It was originally discovered years ago—the goossan outcrop being mined for paint material. As depth was attained the pyrite orebodies were encountered and it has since been worked for this mineral. A new transportation adit was driven in new territory in 1926 and the so-called 'new' section of the mine opened up. All ore is now coming from this section, the old section not being worked at present. Three spontaneous fires have occurred at various periods, the first in 1917, but all were brought under control and extinguished. The new orebody has a

<sup>1</sup> Lawson, Andrew C., U. S. Geol. Survey Geologic Atlas, San Francisco Folio No. 193.



thickness of 25 feet and there is 60 to 80 feet of overburden between and the surface. It has not been entirely explored but all lies above transportation level. The thickest orebody so far found was 40 ft. Both hard and soft ores occur. At present it is running about half and half. Square sets are used in soft ore as it can be almost tamped down. The hard ore requires 60% powder. There is a total of 3000 feet of workings. Fourteen men are employed. The ore is tamped to the mill and ground to pass a  $\frac{3}{8}$ -inch screen, two jaw crushers, a 10 by 12-in. Blake and an 8 by 12-in. Universal, and a set of rolls being used. The pyrite averages about 47% sulphur. It carries \$1 to \$2 per ton in gold and approximately 1% copper, but the total values are not recovered, only the sulphur being used by the Hauffer Chemical Company which is taking the output. Shipments are made over the Key System electric line which passes within 1600 feet of the mill, to the Southern Pacific Railroad.

Bibl: State Mineralogist's Report XVII, p. 33. Bulletin No. 38, p. 349; No. 50, p. 170.

#### SALINES

The chief saline product of Alameda County is sodium chloride, common salt, obtained by solar evaporation of the waters of San Francisco Bay. Small amounts of magnesium salts, potash, and bromine, by-products of the salt works, are also produced.

Before the advent of the white man Indian tribes from the interior made periodic trips to the marsh lands on the shore of the bay and gathered supplies of solar salt from natural reservoirs. Natural deposits up to 8 inches in thickness were found and worked until exhausted by early settlers between 1848 and 1860. The first artificial ponds and works were constructed near Alvarado and Mt. Eden in 1862. By 1868 the works extended from San Leandro Creek to Centerville, a distance of 15 miles, and 17,000 tons were being produced annually. Seventeen companies were engaged in the industry and six steam mills in San Francisco were cleaning and grinding salt.

On the discovery of the silver mines of the Comstock lode there was a scarcity in the market, as all of the salt used in the metallurgical works was sent from San Francisco, and the price reached \$35 a ton.

More than thirty companies have been active in Alameda County since 1862, but all of the smaller operators have been absorbed in more recent years, two large producing companies alone remaining at the present time.

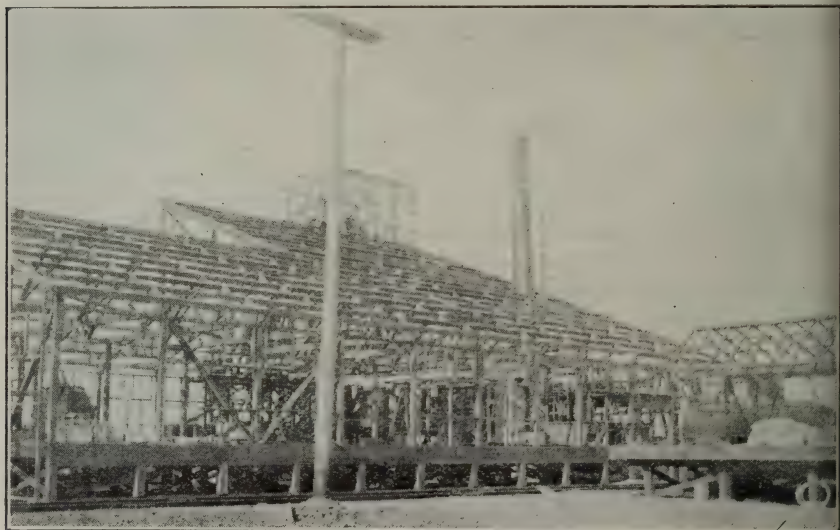
Prior to 1904 only crude salt was produced, but in 1909 the first vacuum plant was established (in San Mateo County), and since then the manufacture of refined salt has been an important part of the industry. Output of the county has gradually increased to about 200,000 tons annually.

Bibl: State Mineralogist's Reports II, pp. 217-226; VIII, p. 30; XII, p. 408; XIII, p. 644; XVII, pp. 33-36; XX, p. 184. Bulletins No. 24, 67, 91. U. S. Geol. Survey Bull. 669. U. S. Bur. of Mines Bull. 146. Review of the Pacific, Mercantile Trust Co. of California, San Francisco, Vol. XV, No. 9.



*Arden Salt Company.* This company owns approximately 9000 acres of salt land in Alameda County. The No. 1 or Arden unit comprises 4000 acres of salt land with large evaporating and crystallizing ponds. The holdings are bisected by the Dumbarton highway toll bridge, the approach of which cuts through Arden (Coyote) Hills. The Arden holdings are developed and producing. A second unit, comprising 5000 acres lying south of No. 1, and nearer to Newark, is now being brought into production. Arden Salt Company and Morton Salt Company are associated in a cooperative agreement whereby all crude salt produced by the Arden Company is refined by Morton Salt Company at their Newark plant and marketed. Arden Salt Company is owned by A. Schilling, Second and Folsom Sts., San Francisco. Plant address, Newark. Otto Zorn, superintendent.

*California Chemical Corporation.* This company, which is affiliated with the National Kellastone Company of Chicago, has a plant at



New plant under construction for California Chemical Corporation, Newark, Alameda County.

Chula Vista, San Diego County, where magnesium chloride and bromine are produced. They also have a bromine plant in San Mateo County and own the Industrial Chemical Corporation, which formerly had a plant at the Arden Salt Works near Arden Hills producing various salts from the bittern water. This latter plant has been dismantled and California Chemical Company is now erecting at Newark a new plant which will take the bitters from Arden Salt Company and Leslie-California Salt Company and produce bromine, magnesium chloride and potassium chloride. The bromine will also be converted into various organic and inorganic bromides. S. H. Barrows is president; M. Y. Seaton, vice president, and P. A. Gross, secretary. Home office: San Francisco.

Arden Salt Company is completing a new salt development project covering 5000 acres at Newark, and about 1 mile of pipe line will bring

bittern from the Arden Company to the new plant and 7 miles of line will deliver bittern from the Leslie-California Salt Company's properties in Alameda County, near Alvarado. The latter pipe line will not be completed until spring. The company expects to be in production of bromine by November, 1929, and of magnesium chloride by December. Magnesium oxide will be added to the output next year. It is expected that 20 men will be employed at the start of operations.

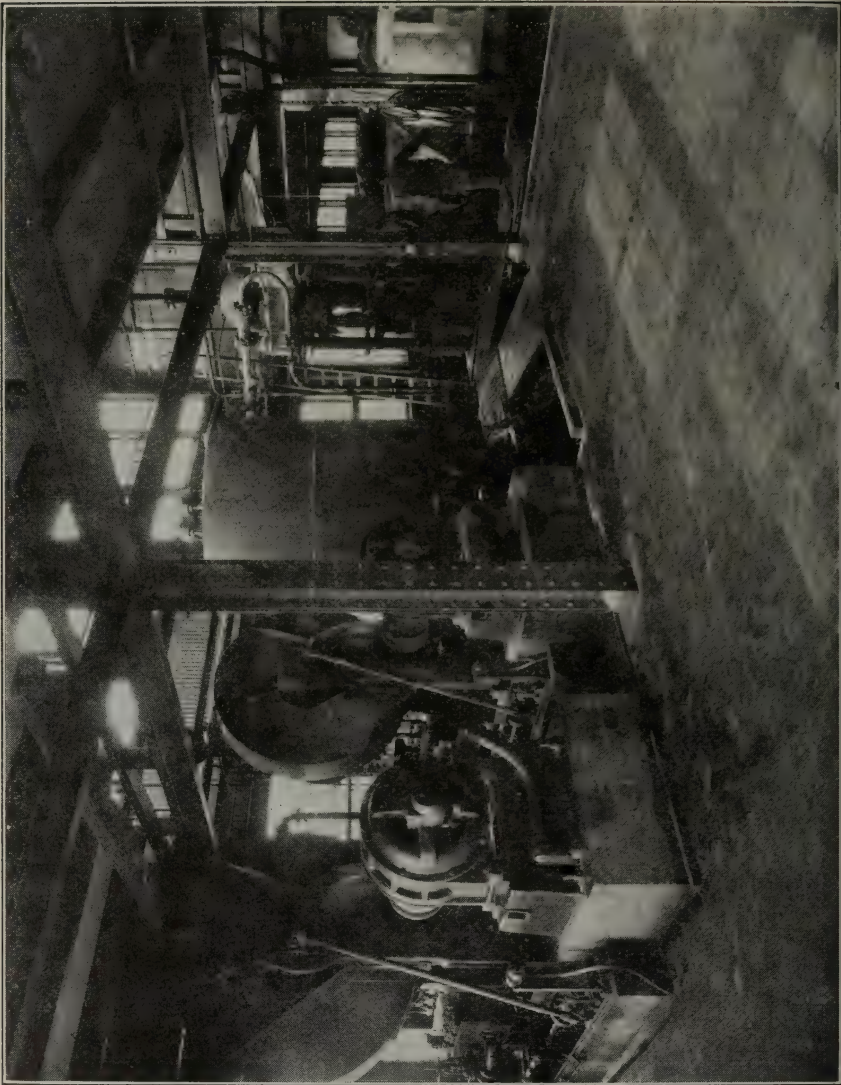
*Leslie-California Salt Company.* This corporation represents a consolidation of the Leslie Salt Refining Company, the California Salt Company and the Continental Salt and Chemical Company, all of San Francisco. The company also owns in its entirety the Oliver Salt Company and its subsidiary, the Pioneer Salt Company, and operates under lease the American Salt Company (Marsicano) and other small land holdings in Alameda County near Alvarado and Mt. Eden. A unit comprising the Oliver Salt Company has been in production since 1872. It has other interests in southern California as well. Approximately 10,000 acres of highly-developed salt lands are owned and controlled on San Francisco Bay, of which 7000 acres are in Alameda County and the balance on the western shore, in San Mateo County. The annual production of crude salt is approximately 160,000 lbs. St. John Whitney, president; L. D. Adams, secretary-treasurer; general office, Alexander Building, San Francisco.

There are two modern refineries, the one near San Mateo taking care of rail shipments, and the one near Alvarado the water shipments.

All salt produced by this company is manufactured from Pacific Ocean water, this being trapped in large receiving ponds during periods of high tide and then as required, pumped into a series of ponds where it is concentrated by solar evaporation. This concentrated salt brine is then pumped into smaller ponds located adjacent to the plants where further solar evaporation precipitates the salt crystals, which in a season build up to a thickness of about six inches. The entire operation, from the time sea water is taken in until the salt is ready for removal from ponds, requires one year. This crude salt is removed from the ponds either by shoveling onto conveyors or into cars and is then transported to the crude salt washers which remove any adhering dirt, after which it is stacked in storage piles for use by the plants as required. Considerable of this salt is shipped in its crude state for use in curing hides and fish, ice cream manufacture, etc., but that for human consumption is put through the refinery.

All refining at the company's refineries is done by the modern vacuum process. The crude salt is transported to a dissolving tank where it is dissolved with distilled water, the resultant brine being pumped into huge storage tanks where it is chemically treated to remove impurities. This purified brine is then pumped to evaporators where it is boiled in a vacuum, the resultant salt being fine cubical crystals; these then pass through centrifugal wringers which extract the bulk of the moisture, the balance being extracted in tumbling barrels where the salt comes in contact with clean hot air, the temperature of which runs from 750° to 800° F. The dried salt then passes over vibrating screens and then goes direct through the filling machines to the various packages. At no time during the entire process, after refining, can this salt come in contact with human hands. Electric

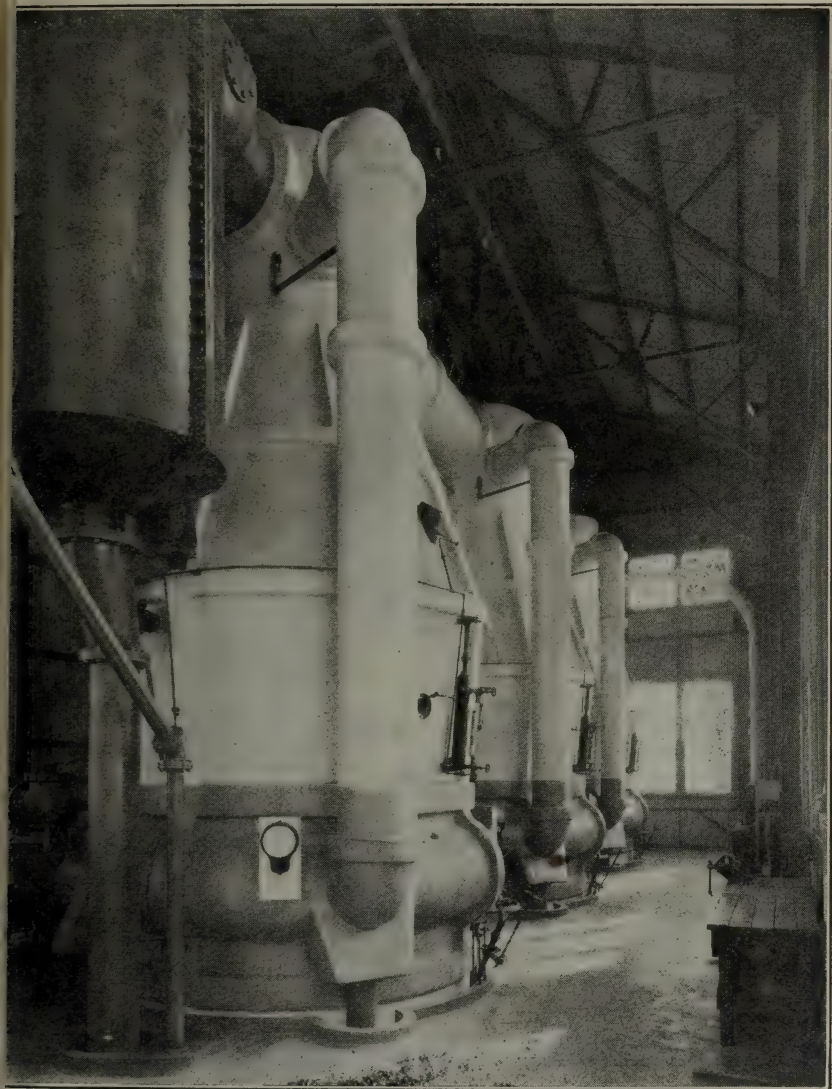






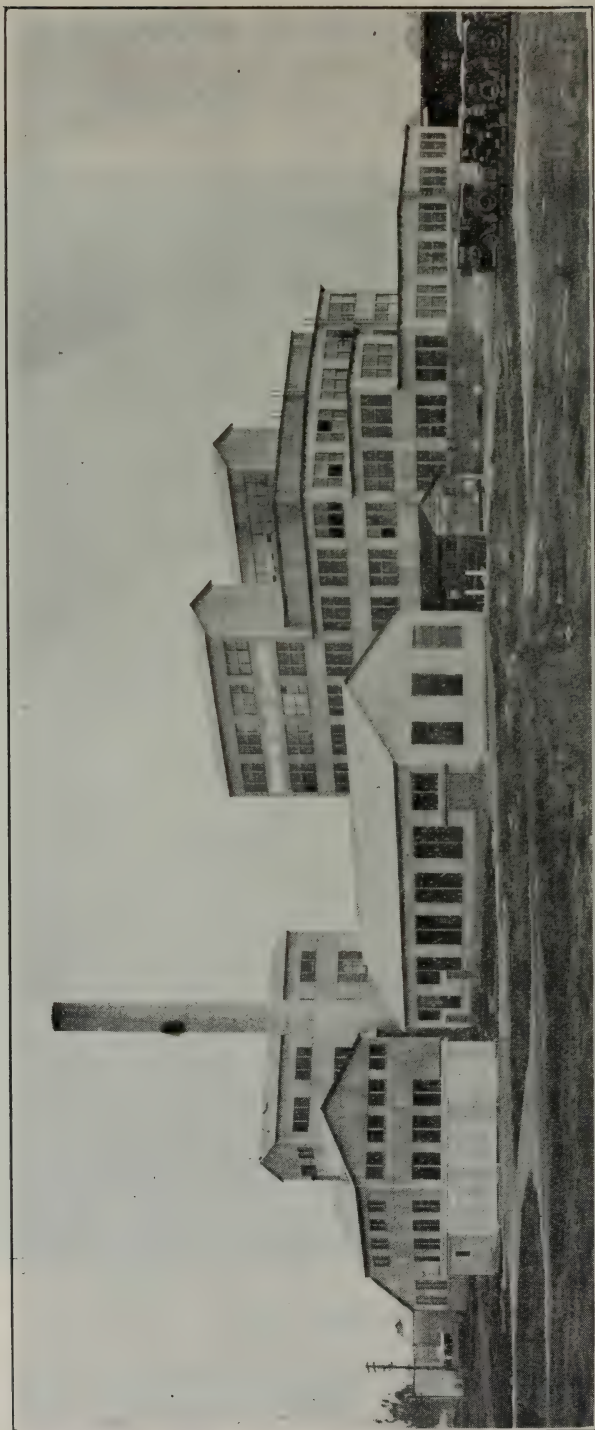
power is used to operate the plants and crude oil for fuel to supply steam and heat the air for dryers. An average of 300 men and girls are employed.

*Morton Salt Company.* This company operates one of the most modern salt refining plants in the world at Newark, Alameda County.



Triple effect vacuum pans at salt refinery of Morton Salt Company, Newark, Alameda County.

Their business is nationwide, and in addition to the Newark Salt Works the company owns and operates three plants in Michigan, two in Utah and one each in Kansas, Texas and Illinois, all grades of refined



Panorama of Salt Refining Plant of Morton Salt Co., Newark, Alameda County.

vacuum process salt being produced. General offices are in the Morton building, 208 West Washington Street, Chicago, Ill. Officers are Jay Morton, president; Sterling Morton, secretary; Daniel Peterkin, treasurer. Address of local plant, Newark, California; G. B. Hess, manager.

Morton Salt Company does not produce crude salt from San Francisco Bay waters, but operates its refinery in conjunction with the Arden Salt Company, the latter company owning two large acreages of salt-producing lands near Arden and Newark, the entire output of which is refined and marketed by Morton Salt Company.

The Newark plant was completed in October, 1926, and is devoted to the production of the highest grade of vacuum salt in its various forms. It serves the coastal states and Orient.

The refining process of the Newark plant is a continuous cycle carried on 24 hours a day, and involves much automatic machinery and modern packaging equipment for the finished product. A concentrated raw brine is first made by dissolving the crude salt crystals produced by solar evaporation from the salt ponds of the Arden Salt Company. This raw brine is carried through successive stages of the vacuum process by first treating it chemically for the removal of impurities and then evaporating it to the crystallization point in huge triple-effect evaporators. The salt is then given a preliminary drying in centrifugal machines and a final drying in a large rotary kiln dryer. The dried aggregate is screened into six different sizes and stored in bins from which it is withdrawn into automatic packaging machines. The plant has a daily capacity of approximately 400 tons. There are about 90 persons, both men and women, employed—the latter in the packing department.

#### STONE INDUSTRY

(Crushed Rock, Sand and Gravel.)

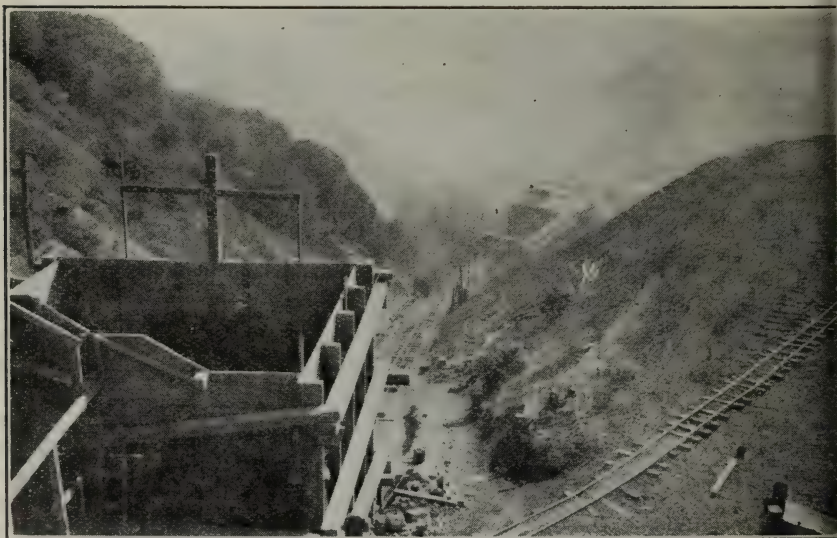
*Bilgers Property Company* (formerly Oakland Paving Company). Porter Shaw, president; E. T. Harlowe, manager. Office: 5000 Broadway, Oakland. Bilgers Property Company acquired this quarry, one of the oldest and largest in the bay district, in 1928. It has been worked almost continuously since 1870. The quarry is situated on McAdams Street, about two blocks east of Broadway. The rock is a hard, fine-grained, bluish-gray metamorphosed sandstone of the Franciscan formation.

There are two large circular open cuts, one about 1000 feet in diameter and the other 500 feet, with high faces. The rock is shot down to the floor and loaded by steam shovel into trains of 3-yd. side-dump cars. These are handled by a Porter steam locomotive on a 36-in. gauge track around the face. The cars are dumped in a hopper feeding a 48 by 60-in. jaw crusher set in a pit in the floor. An inclined pan conveyor elevates the discharge to a No. 8 gyratory, and after passing this the material is taken by conveyor belt through a tunnel piercing the wall of the cut to the secondary crushing plant. This is equipped with two No. 5, two No. 4 and one No. 2 gyratories and suitable screening units to produce all standard sizes from 3-in. to dust. Crushing is done dry. Motors totaling 825 horsepower are installed, but only 350 horsepower is being used. The plant has a capacity of 400 to 600 tons per day. Twenty-five men are employed. A Brown-





Portal of tunnel under glory holes. Bowersmith, Tuttle & John Quarry, Alameda County.



Looking down gravity tram to crusher plant. Waste dump on right. Bowersmith, Tuttle & John Quarry, Alameda County.

list caterpillar crane handles the material in the yard. All deliveries are made by truck from bunkers or stock piles, there being no railroad connection. J. W. Pike, superintendent.

*Bowersmith, Tuttle and John.* In October, 1929, this firm, a partnership, with offices at 528 Oakland Bank Bldg., Oakland, acquired all the properties and equipment of Central Construction Company. The Alameda County properties include the old Leona Heights Quarry (now called No. 9); the Hyland Quarry (now No. 2), and Leona No. 7 Quarry, referred to as the Ransome-Crummey Quarry in former reports.

The plant at No. 9 was destroyed by fire and this property is idle. No. 2 (Hyland) is only operated as occasion requires, main operations in this county being confined to Leona No. 7 Quarry located at 73d Ave. and Mountain Blvd., Oakland, which is operated continuously.

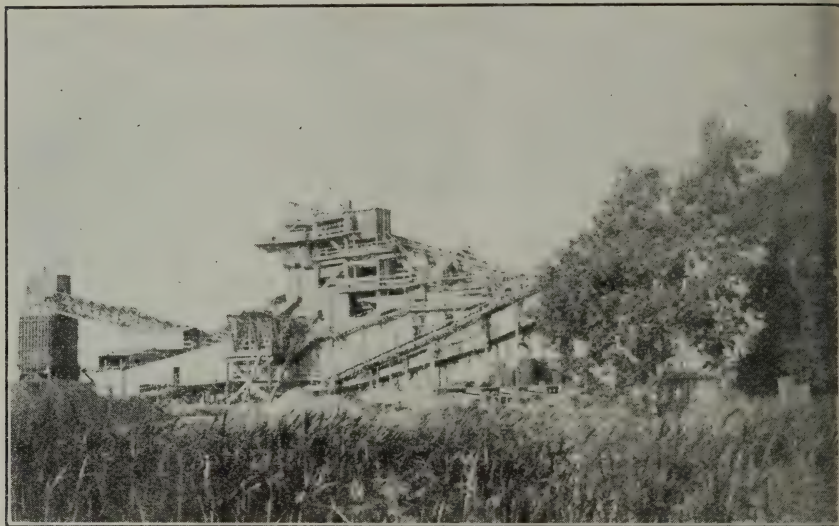
The rock here is a siliceous rhyolite or trap rock which runs up to 8½ in. hardness. The formation contains seams of calcareous material from knife-blade to two inches in width, but the limey portion is eliminated by continuous screening, the product passing over seven sets of screens. Fining is by glory holes spaced at intervals of about 100 feet, the faces of which vary from 75 feet to 300 feet in height. A tunnel has been driven entirely through the hills to assist ventilation and the broken rock is dropped from the glory holes through chutes, and loaded into 1-yd. side-dump cars in the tunnel. Trains of 7 cars each are drawn by a 4-ton Westinghouse D. C. locomotive to the primary crushing unit. The cars dump on a grizzly, the oversize goes to a bunker, then by gravity tram to the main plant, where it is crushed in a battery of one No. 6 and one No. 5 Allis-Chalmers gyratories. Undersize from the grizzly passes through a revolving scalping screen, minus 1½-in. going to dump and plus 1½-in. joining the oversize. The entire feed passes over the first set of revolving screens, which cut out five sizes from 2½-in. down. Minus 1½-in. rock is passed over vibrating screen sets and all standard sizes from 2½-in. to dust are produced. Crushing is done dry. Spalls from the first set of screens go to one No. 3 Austin, one No. 3 Allis-Chalmers and one 2F Telsmith secondary crushers and screens. The capacity of the plant is approximately 500 tons per day, and the crew in quarry and plant, including the superintendent, comprises only 11 men, there being no hand labor. Electric power is used, total installation 230 horsepower. Deliveries are made over the California railroad (Key System) and by trucks. Yard equipment includes a B. & H. caterpillar-mounted crane, a Barber-Green loader and steam and gas power shovels. About 16,000 tons are in storage piles. M. J. Shaffer, plant superintendent.

*Centerville Sand and Gravel Co.* This is a reorganization of the former Pacific Rock Co., of which Lee Frontz of Niles was one of the principal promoters. E. W. Burr of Hayward is named as the new president, and M. T. Scott, manager. The company's holdings consist of 68 acres situated about 1 mile northeast of Centerville, said to be the last unappropriated gravel land in what is known as the fifty-cent zone. A railroad spur has been built to the property and there is a Brownhoist railroad crane on hand. Foundation excavations for a plant have also been made, but further activities are apparently await-



ing financing. No one was at the property when visited. Surveys are reported to show 11,000,000 tons of sand and gravel available.

*Haywards Building Materials Co.* (Decoto Plant). This sand and gravel plant is situated on Alameda Creek  $1\frac{1}{2}$  miles south of Decoto. Operations began in 1927. Office of company: Atherton and Jackson Sts., Haywards. The deposit consists of creek sand and gravel running



Kaiser Paving Company's plant at Livermore, Alameda County. View from rear side.

about 60% sand and 40% gravel. A drag-line with  $\frac{3}{4}$ -yd. LeClaire scraper delivers the material to the plant. It is elevated by bucket elevator and screened, all over 2-in. being crushed in a jaw crusher and returned to the screening section. At present the gravel is not washed, but there is a well which can supply water for washing, if desired. Electric power is used. Capacity about 225 yards per day. All deliveries are made by trucks, being there is no rail connection. The crew consists of 3 men. Tony Mazza, superintendent.

*Johnson Gravel Plant.* Owner, J. F. Johnson, P. O. Box 232, Livermore. This is a small plant without rail connection located one mile west of Livermore. The deposit consists of 12 feet of medium size gravel. A team and scraper delivers to a hopper, from which the material is elevated to the top of the plant, screened, the oversize crushed, and returned to the screens over the loading bunker. A 20-h.p. motor furnishes the required power. Capacity about 50 yards per day; the owner working alone or with a man or two, depending on demand. The material is not washed and is used mainly for road work and by ranchers.

*Kaiser Paving Company.* The large commercial sand, gravel and crushed rock plant at Livermore owned by this company is a development of the plant built in 1924 to supply the company's own needs on paving contracts. Officers of the company are: H. J. Kaiser, president;



G. G. Sherwood, secretary; S. McWhorter, treasurer; T. M. Price, manager; J. C. Tompkins, superintendent of the Livermore plant. Home office: 1522 Latham Square Building, Oakland. Plant address: Livermore.

The gravel deposits in this area are quite thin, being not over 7 to 12 feet in depth. Two 2-yd. Diesel shovels are used alternately to dig the material. The shovels dump into 10-yd. hopper-bottom cars which are hauled in trains of 7 cars each by 24-in. gauge Diesel-powered locomotives, of which there are three at the plant. The present haul from pit to plant is 2 miles. Cars are dumped into a track-hopper from which a conveyor belt leads to the top of the plant. Oversize from the scalper screen (plus 3-in.) is crushed in a No. 49 Kennedy gyratory followed by a No. 4 Symons cone. The crushed rock is screened and graded separately from the uncrushed gravel. A set of 10 by 60-in. Garfield rolls are included in this section for special crushing. The minus 3-in. material is passed through a series of conical revolving screens, followed by cylindrical and vibrating screens and products ranging from sand to 3-in. produced in standard sizes designated as Nos. 1-2-3-4-5-6. All products are washed, water being obtained from two wells with turbine pumps. About 2000 gallons are used per minute, a 350,000-gallon reservoir being filled during the night. A total of 750 horsepower is required in the plant. Motive equipment also includes one No. 6 Brownhoist 12-ton steam locomotive crane and one gasoline crane for loading from stock piles. Bunkers load to railroad



Plant A, Pacific Coast Aggregates, Inc., near Elliott, Alameda County.

cars or trucks. The capacity of the plant is 300 tons per hour. Twenty-five men are employed the year round.

*Pacific Coast Aggregates, Inc.* This California corporation, organized in 1929, is a merger of a majority of the important producers and distributors of sand, gravel and crushed rock in central California. Norman B. Livermore, president; G. G. Jamison and F. W. Erlin, vice

presidents; Chas. C. Roller, secretary-treasurer. Home office: Hunter-Dulin Bldg., 111 Sutter St., San Francisco. The company controls 20 producing plants and 25 distributing plants in the San Francisco Bay region and Sacramento and San Joaquin valleys. Delivery equipment includes 97 motor trucks, 18 barges and 7 tugs. Their total sand, gravel and rock deposits consist of 2356 acres owned in fee and 1113 acres under lease, said to be sufficient to meet their requirement for 50 years at the present rate of production. Pacific Coast Aggregates, Inc., have five producing properties in Alameda County, including the former properties of Rhodes-Jamieson Co. (now Plant A); G. and M. Gravel Co. (Plant B); Coast Rock and Gravel Co., Elliott (Plant C); California Rock Co. (Plant D), and Coast Rock and Gravel Co., Niles (Plant E).

Plant A. This is a modern sand and gravel plant constructed in 1927 entirely of concrete and steel. The plant is opposite Elliott Station on the Southern Pacific railroad, about half way between Pleasanton and Livermore. It differs from the other Alameda County plants in that the gravel and sand were dug by a floating suction dredge and pumped to the plant. The capacity of Plant A is 125 tons per hour, but the cost of delivering material to the plant by this method is said to be high, and it is not being operated at present, all shipments being drawn from stock piles.

Plant B. This plant, which was built in 1924, is also at Elliott, two miles east of Pleasanton. The deposit consists of sand and gravel along Arroyo del Valle Creek. Its depth is 38 feet to the first clay stratum, a bed about 2 feet thick, then 267 feet of gravel to the next clay bed, as determined by well-borings. The material is excavated by a 1-yd. Osgood gas shovel, dumped in a field bunker, loaded into 10-yd. hopper-bottom cars and drawn to the primary crushing plant by cable and American double-drum hoist. It then goes to a scalping screen, oversize being crushed in a 12 by 24-inch jaw crusher. All fines are then taken by an incline belt conveyor to the main plant. It is passed through a series of Link-Belt and Bodison revolving screens to bins. The oversize from these screens is recrushed in a Chalmers gyratory in closed circuit. Crushed rock and gravel in  $2\frac{1}{2}$ "- $1\frac{1}{4}$ ";  $1\frac{1}{4}$ "- $\frac{3}{4}$ ";  $\frac{3}{4}$ "- $\frac{3}{8}$ ";  $\frac{3}{8}$ "- $\frac{1}{4}$ " and two sand products, concrete sand and fine sand, are produced. All the product is washed, water being obtained from an artesian well 458 feet deep with flow of 300 gallons per minute and another well 138 feet deep which pumps 250 gal. per min. Electric power is used throughout, approximately 300 horsepower being installed. Yard storage is handled by an Ohio clam shell locomotive crane. Trucks or railroad cars may be loaded from the bunkers. The usual crew is 13 men and the capacity of the plant 20 cars per 9 hour shift. At the time of visit shipments were being made from the stock piles only. C. A. Barton is superintendent.

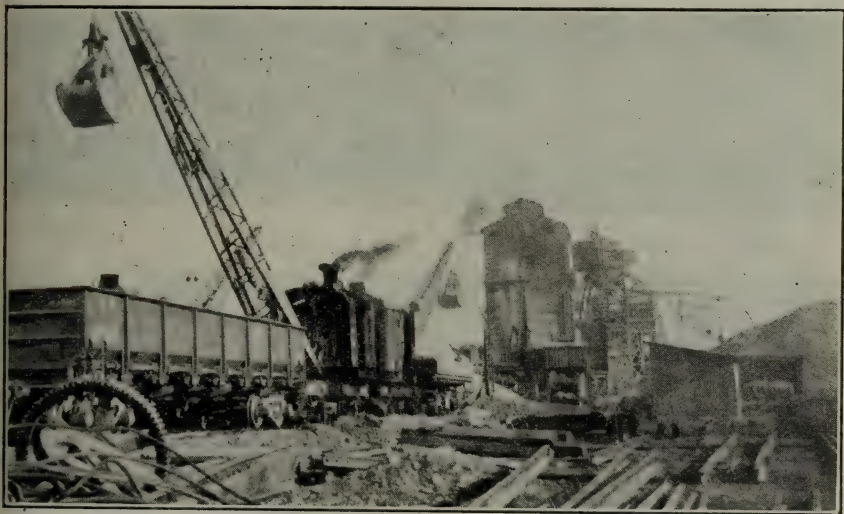
Plant C. Production was started by the former owners at this pit in 1924. The plant is situated opposite Elliott Station on Arroyo del Valle Creek. Gravel here attains an average depth of 40 feet. The digging is done with an 80-B Bucyrus electric shovel with  $2\frac{1}{2}$ -yd. dipper which loads into trains of 30-yd. Western automatic dump cars. These are hauled by a 20-ton Whitcomb steam locomotive to a track hopper over a concrete tunnel. A 30-in. inclined belt conveyor in the



tunnel delivers the material to a scalping screen and prewashing plant. Oversize from the screen goes to two 6-N. Allis-Chalmers gyratory crushers. The crusher product and fines from the screen are conveyed by a second 30-in. belt to the sizing and final washing section.

Four-deck shaker screens over the bins are used here, and these are followed by two sandwheels which remove the sand from the wash water. The washed products are delivered to railroad cars or trucks in all standard sizes from 3-inch to sand. Water for washing is obtained from wells, about 1800 gallons per minute being used. All equipment except the Brownhoist storage yard crane and locomotive is operated by electric power, a total of 1400 horsepower being required. Plant C has a capacity of 260 tons per hour, the average crew consisting of 35 men. In active operation. L. E. Thomas, superintendent.

Plant D. This plant, which was erected in 1924, is also situated near Elliott about midway between Pleasanton and Livermore, the



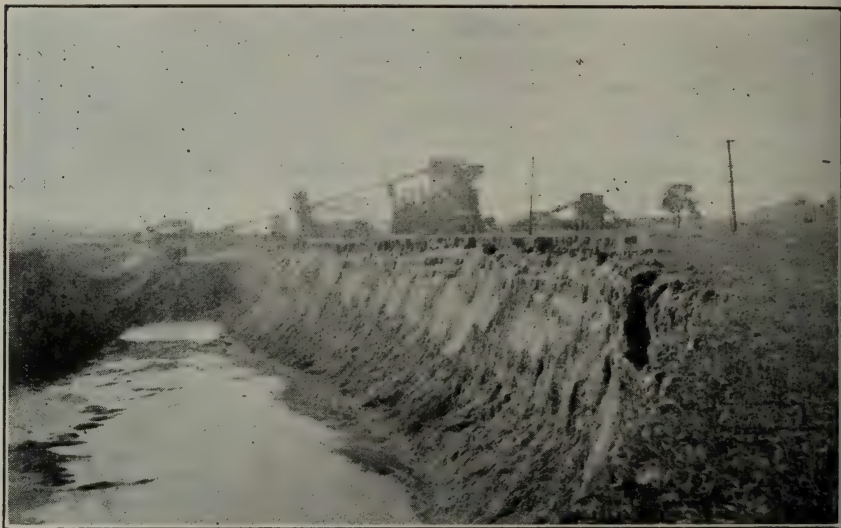
Plant C, Pacific Coast Aggregates, Inc., near Elliott, Alameda County.

deposit consisting of old channel or bench gravels along Arroyo del Valle Creek.

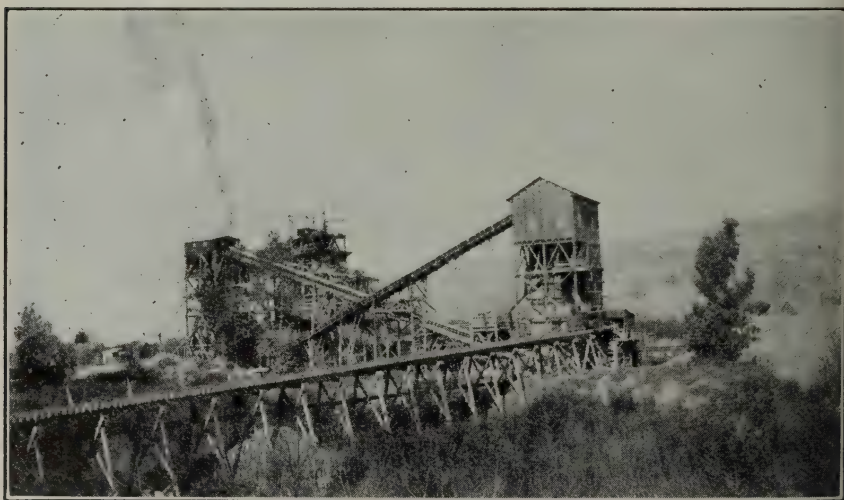
A Marion 37 combined shovel and drag-line is used for digging. The top surface is taken off with the shovel rig ( $1\frac{3}{4}$ -yd. dipper) and the second cut made with the drag-line ( $1\frac{1}{2}$ -yd. drag). The sand and gravel is loaded into 12-yd. side-dump cars which are hauled by a 12-ton Plymouth locomotive to the plant hopper. A 30-in. inclined conveyor belt transfers the material from the hopper to a revolving scalper screen, the oversize going to a boulder bin. The boulders are crushed in a Telsmith primary and Symons cone-type secondary crusher. The crusher product and undersize from the screen then pass to a series of conical revolving sizing screens which distribute to bins. Following the conicals are two Traylor vibrating screens for roofing gravel. The sand product is washed in a Bodison classifier and a reclaiming sand-wheel returns fine sand, of which one grade only is produced. Gravel



and crushed rock sizes run 3", 2½", 1¾"; also ¾"-¾"; ¼"-½"; ½"-¾"; ¾"-1¾", 1¾"-1¾"; 1¾"-2½"; 2½"-3". Electric power is used for plant operation and steam on the motive equipment. Approximately 425 horsepower is installed. The plant has a rated capacity of 165 tons per



Plant D, Pacific Coast Aggregates, Inc., near Elliott, Alameda County.



Plant E, Pacific Coast Aggregates, Inc., Niles, Alameda County.  
View from rear.

hour. The crew consists of 15 men per shift. Deliveries are made direct to railroad cars or trucks. J. S. Silva, superintendent.

Plant E. This is the only one of the five Alameda County plants of Pacific Coast Aggregates, Inc., not situated in the Livermore Valley near Elliott Station. Plant E, which is much older than the other

ur, operations having begun here in 1910, is on Alameda (Niles) creek at Niles. A great deal of material has been removed from this area during past operations. A Ledge-wood slack-line excavator with a 1-yd bucket is used to load a train of hopper bottom dump cars. The gravel train is hauled to the plant by a Plymouth steam locomotive and the cars dumped into a feed bin hopper, from which an inclined belt conveyor delivers the material to the top of the plant. The material goes to a 4-in. grizzly which separates the screen-section feed from the crusher-section feed. In the crusher section there is a No. 5 Gates gyratory followed by a screen and Symons disc crusher. The discharge from the crushers and undersize from the screen pass to the crushed rock plant (a recent addition) where the following sizes of crushed rock are produced:  $\frac{1}{4}$ "- $\frac{5}{8}$ ";  $\frac{5}{8}$ "- $1\frac{1}{4}$ ";  $1\frac{1}{4}$ "- $2\frac{1}{2}$ ". Gravel and sand from the first grizzly pass to the screening and washing section and are put through a series of conical revolving screens producing  $\frac{1}{8}$ "- $1\frac{1}{2}$ ";  $1\frac{1}{2}$ "- $\frac{3}{4}$ ";  $\frac{3}{4}$ "- $\frac{1}{2}$ ";  $\frac{1}{2}$ "- $\frac{3}{8}$ " and two grades of sand, a fine (plaster) sand and concrete sand, from  $\frac{1}{4}$ -in. down. Crushed rock, gravel and sand are all washed. Deliveries are made to trucks or railroad cars, both the Southern Pacific and Western Pacific having spurs to the plant. Electric power is used throughout the plant, there being 100 horsepower installed. The locomotives are gasoline operated and the Brownhoist locomotive crane in the yard is steam-powered. The output is approximately 120 tons per hour. Storage piles contain 50,000 yards. Twenty-four men constitute a shift. L. O. Bunting, superintendent.

*Ramos Bros. Quarry.* This quarry at Alto Vista, 3 miles south of Hayward, has been worked for the past four years by Ramos Bros., 98 Castro Street, Haywards. There is no crushing, screening or washing plant, the broken rock simply being scraped to a loading platform by team and dumped in trucks. It is used mainly as filling.

*Russell Bros. Quarry.* Owners: B. and L. Russell, 1192 Russell Way, Hayward. This quarry is situated in the rear of the Haywards High School. It was opened up about 10 years ago. The rock breaks down in small pieces when blasted and the broken material is drawn to a bunker with a drag-line scraper and sold without washing or screening. One or two men are employed, depending on demand.

*San Leandro Rock Company* (Lake Chabot Quarry). This company acquired the Lake Chabot quarry in September, 1928, and has operated it continuously since that time. O. F. Chichester, president; L. Clines, secretary. Office, 1273 Foothill Blvd., San Leandro. The quarry is situated two miles east of San Leandro on Lake Chabot road near the dam forming the lake. It was first opened up in 1886 by E. B. and A. L. Stone Company, but several changes in ownership have occurred during the interim. The rock is a hard blue metamorphic sandstone commonly referred to as 'trap' rock.

The quarry is in the form of a circular glory hole with steep sides about 300 feet in height from toe to top. Air and churn drills are used in putting in holes around the sides. When blasted the broken rock falls through a hole into cars in a tunnel below the quarry floor. These are drawn to the crushing plant and the rock passed over a grizzly. Oversize goes to a Gates gyratory for crushing. The crusher



discharge and fines from the grizzley are separately screened through a series of trommels and various sizes from 3-inch down delivered to bins from which trucks are loaded. Electric power is used, a total of 100 h.p. being installed. The product is not washed. An average of 10 men are employed. C. Hopper, manager.

Others who occasionally take out rock or gravel at various points in the county are: *Hanifen Trucking Company*, Pleasanton; *Kemper Bros.*, Hayward; *R. P. King*, San Lorenzo, and the *Mountain View Cemetery Association*, Piedmont.

Bibl: (Stone Industry in Alameda County) State Mineralogist's Reports X, p. 125; XII, pp. 386, 388; XIII, p. 624; XVII, pp. 36-40. Bulletin No. 38, pp. 311-316.

## MENDOCINO COUNTY

By CHAS. VOLNEY AVERILL, Mining Engineer

### Geography and Topography.

The Pacific Ocean forms the western boundary of Mendocino County; and the center of the county is about 140 miles north of San Francisco by road. The county is occupied largely by mountains of the Coast Range; and, while the elevations are not high, the streams have cut the country into such steep slopes that the effect is quite mountainous. On the west is a strip with the typical climate of the Pacific coast, very mild both in winter and summer. Inland, several valleys lie between mountain ranges; and their climate is a little different, warmer in summer and colder in winter than along the coast. The area is 3453 square miles; and the population 24,116 persons by the census of 1920.

In the southeastern part the Russian River runs south through a valley that is known by different names in different sections. Ukiah, the county seat is on this river. The Eel River flows northwest through the northern and central portions of the county; and to the west many small streams flow directly into the Pacific.

### Industries.

The location, climate, and natural resources of this county contribute to quite a variety of industries. Important among these is agriculture of all kinds. Stock is raised in many places; and dairying is on a firm basis with several local creameries making butter and cheese. Fruits, such as apples, pears and plums, also grains and vegetables are all produced. At Hopland, on the Russian River, in the southern part of the county, is a thriving poultry industry.

Redwood timber covers a wide belt in the western part of the county, a few miles inland from the coast, giving rise to a large lumbering industry. On the coast sawmills are located at Greenwood, Fort Bragg, Caspar, Mendocino, Albion and Westport; and inland at Glen Blair and Willits. The northwestern corner of the county is in the California National Forest, where there is a protected stand of pine timber.

Commercial fishing is quite an industry just south of Fort Bragg, with the mouth of the Noyo River as the base of operations for the fleet of fishing boats. Many tons of fresh fish are shipped from here to the San Francisco market each week, some concerns making ship-



ments daily; and a large fish cannery is operated also. At Ukiah is located a State Fish Hatchery, where spawn taken from the State Fish and Game Commission's plant on Eel River is hatched. Trout fry are distributed from this hatchery to streams in various parts of northern California.

Power is generated just to the north of Potter Valley by the Snow Mountain Water and Power Company. After the water from Eel River has served its purpose at the generators, it is available for distribution by gravity to irrigate lands to the south. The Pacific Gas and Electric Company absorbs the excess power from this plant.

#### Transportation.

The Northwestern Pacific Railroad runs practically through the center of Mendocino County, connecting it with San Francisco Bay points on the south and Eureka on the north. At Willits is the division point of this road, also the terminus of the railroad running west to Fort Bragg on the coast. Transportation by water is available at Fort Bragg and several other towns on the coast, the best protected harbor being at Mendocino.

A state highway with hard surface follows in general the line of the Northwestern Pacific in the southern part of the county, but swings further to the west in the northern part, and extends to points in Oregon. From Ukiah to Upper Lake, and from Hopland to Lakeport are other state highways, also up the Navarro River for about twelve miles. These are all excellent roads with hard surface and easy grades. The Ukiah-Lake Tahoe state highway, of which the road to Upper Lake forms a part, is nearing completion as far as the Sacramento Valley; and the parts already finished make this a good route at present. From the coast to the interior, many roads cross the mountains; but with the exceptions noted above, these have a tendency toward steep grades and surfaces that become soft when wet. Towns along the coast are connected by a fair road with graveled surface.

#### Geology and Mineral Deposits.

In general, Tertiary and Cretaceous sedimentary formations are found along the coast; and Jurassic sediments and metamorphosed sediments in the interior.<sup>1</sup> However, little detailed geological work has been done in this region; and a closer study will, no doubt, show that other formations are present. Little attention is being given to the development of mineral deposits; but, while the large exposures of sedimentary formations may be unfavorable to the finding of many minerals, a closer study would undoubtedly result in the discovery of additional mineral resources, such as the limestone that has just been developed. The total recorded mineral production of the county is shown in the attached tabulation.

<sup>1</sup> Geological Map of the State of California, State Mining Bureau, 1916.

## MINERAL PRODUCTION

Year	Brick		Manganese ore	
	M	Value	Tons	Value
1880.....				
1881.....				
1882.....				
1895.....				
1896.....				
1898.....	258	\$1,080		
1899.....	200	1,800		
1900.....	25	400		
1901.....	200	2,500		
1902.....	200	2,000		
1903.....	550	5,580		
1904.....	260	3,120		
1905.....	635	6,470		
1906.....	500	5,000		
1907.....	400	4,000		
1908.....	260	2,600		
1909.....	150	1,500		
1910.....				
1911.....	160	1,600		
1912.....				
1913.....				
1914.....				
1915.....			2,858	\$2
1916.....			1,735	4
1917.....	1		1,541	4
1918.....			1,432	5
1919.....				
1920.....			1	
1921.....	1		1	
1922.....	1			
1923.....				
1924.....	550	7,125		
1925.....	1			
1926.....				
1927.....	1			
1928.....				
Totals.....	1,348	\$44,775	7,566	\$18

<sup>1</sup>Includes crushed rock, rubble, rip-rap, sand, gravel.

<sup>2</sup>See under 'Unapportioned.'

DOCINO COUNTY, 1880-1928.

Mineral water		Miscellaneous stone <sup>1</sup> , value	Miscellaneous and unapportioned		
Gallons	Value		Amount	Value	Substance
				\$733	Gold.
				125	Silver.
				1,000	Gold.
			50 tons	150	Coal.
			450 tons	2,250	Bituminous rock.
17,470	\$6,988				
24,875	8,048				
27,950	8,220				
28,575	7,898				
38,900	13,000				
40,000	12,000			75	Gold.
90,000	18,000			40	Gold.
40,000	9,800			19	Gold.
45,000	9,800				
45,000	9,800				
45,000	9,000	\$1,200		18,000	Unapportioned, 1900-1909.
		500			
		300			
		9,450			
		560			
		1,500			
		8,275	300 tons	2,400	Magnesite.
				2,000	Other minerals.
		5,600		4,300	Brick, chromite, magnesite.
		5,000		226	Gold, platinum.
		7,000	555 tons	44,200	Chromite.
		7,500		7,214	Chromite, platinum.
				18,610	Chromite, manganese, natural gas, platinum
				1,509	Gold.
		40,000		13	Silver.
				3,200	Brick, manganese, natural gas, platinum.
		18,762		1,800	Brick, natural gas, platinum.
		48,360		5,050	Coal, natural gas.
		49,680		3,963	Coal, natural gas, platinum, manganese.
		11,603		4,930	Brick, coal, natural gas.
		15,750		50	Other minerals.
		44,630		3,040	Brick and natural gas.
		40,420		70	Unapportioned.
442,770	\$114,554	\$316,090		\$124,967	



## MINERAL RESOURCES

## BRICK

Brick and tile have been manufactured both at Mendocino and Ukiah, at both of which places good deposits of clay are available. This industry has not grown to one of any great size, much of the brick used in the county having been shipped in by rail.

W. N. Briggs of Ukiah produced brick in 1927, but none in 1928.

## COAL

The occurrence in Mendocino County of coal of good quality has been known for many years. In a report published in 1877, Goodyear<sup>1</sup> mentions the seam cut by Eel River in Sec. 11, T. 21, N., R. 13 W.; and states that it is 14 to 15 feet thick. State Mineralogist's Report VII, for the year ending October 1, 1887, states that the coal is of a better grade than that then being mined at Mt. Diablo, and in fact the best known to exist in the state. In this report, attention is called to the fact that the region has been much disturbed, and that faulting might prove troublesome. Lack of railroad transportation was a great drawback at that time; but a railroad now runs within six miles of deposits, if the distance is measured in an air line. Laizure<sup>2</sup> has described the occurrence of coal here, giving both the history of the region and the developments to that date, in the September, 1923, Chapter of State Mineralogist's Report XIX. Copies of this are still available, so the description given here will be confined to the more recent developments.

*Carbon Company* controls 1240 acres of land in Secs. 13, 24 and 25, T. 21 N., R. 13. W. J. Cal. Ewing is president, and Frank T. Thompson, 1120 Park Ave., Emeryville, California, is secretary.

The last work was done at this mine during the period from February, 1923, to August, 1926. The mine was reached by eleven miles of road from Dos Rios and a low-water bridge across the Eel River. Four miles of this road is now washed out, and the bridge is gone. The extent of the workings is indicated on the attached sketch, which was supplied by Mr. A. L. Fisher, who was formerly in charge of the operations. As noted on the sketch, these workings have caved at the surface, and are now full of water. Mr. Fisher states that all of this work was in coal of a width of 12 feet, with the exception of a pinch near the surface; and he thinks that an estimate of 15,000,000 tons is justified, basing this on these workings and on the outcrops. The main slope follows the coal; but it does not follow the true dip; and its angle with the horizontal is not as steep as that of the dip.

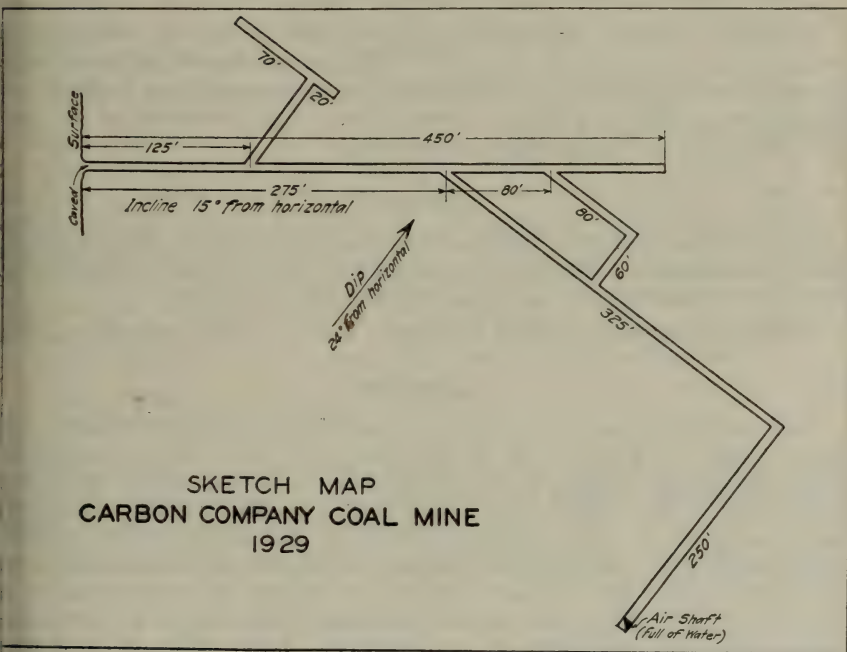
Analyses published in State Mineralogist's Report XIX (see reference above) indicate that this coal is of a very good grade of sub-bituminous, that would be satisfactory for domestic use and under boilers. The ash content is quite low; but the moisture in all of the samples so far obtained has been high. This may be due to the fact that the workings reach points only about 100 feet below the surface;

<sup>1</sup> Goodyear, W. A., *Coal Mines of the Pacific Coast*. Bancroft & Co., publishers. San Francisco, 1877.

<sup>2</sup> Laizure, C. McK., *State Mineralogist's Report XIX*, pp. 145-154, 1923.

and the moisture may decrease with depth. Rough tests on a small scale have indicated that the coal will yield a good quality of soft coke, which is also low in ash. Coal of a better grade than any that has yet been mined commercially in California could probably be produced here.

Bibl: (Coal in Mendocino Co.) State Mineralogist's Reports IV, pp. 14, 270; V, p. 105; VI, p. 117; VII, pp. 149, 189; X, pp. 314, 317; XI, p. 255; XII, p. 56; XIII, p. 54; XIV, pp. 415, 418; XVII, p. 144; XIX, p. 145; XX, p. 87. U. S. Geol. Survey Min. Resources W. of Rocky Mts., 1875 (R. W. Raymond), pp. 190, 192; 1887, p. 210.



**Flood Estate.** The estate of James L. Flood owns 23,000 acres in northeastern Mendocino, including the land in Sec. 11, T. 21 N., R. 13 W., on which is located the outcrop of coal that is cut by the middle fork of Eel River. This is the outcrop that was reported as early as 1877 in the publication mentioned above. It has never been definitely correlated with the vein developed by the Carbon Company.

James E. Walsh, executor of the Flood Estate, Flood Building, San Francisco, states that an estimate of 8,000,000 tons in an 8-ft. vein has been made for this deposit. This estimate was based on six drill-holes and 40 to 50 feet of tunnel at the river level. The last work was done in 1915.

Bibl: See above under Carbon Company for county bibliography.

#### COPPER

A little prospecting has been done on small copper showings in a dozen places in the county, but nothing of consequence has been

developed; and practically nothing is being done with the prospect at the present time. The Whipple prospect is the only one that was visited by the writer.

*Redwood Copper Queen Mine.* This property included 840 acres of patented land in Secs. 17, 20, T. 12 N., R. 13 W. Development work indicated a mineralized zone 300 feet long, 10 to 40 feet wide, and 12 feet deep, carrying kidneys and lenses of sulphide ore. The largest of these was 75 feet long and six feet thick; and it consisted of heavy iron sulphide carrying as much as 9% copper. In 1906, 400 tons were shipped to a chemical plant for the manufacture of sulphuric acid.

Bibl: State Mineralogist's Report XIV, p. 419.

*Whipple Prospect* is located on the ranch of Roy E. Whipple or Philo in Sec. 17, T. 14 N., R. 14 W. Copper carbonate has been found in seams a fraction of an inch wide in a metamorphosed sedimentary formation, probably a shale. Development work consists of an open cut about 15 feet long and 10 feet wide.

#### CHROMITE

*O. B. Filbin* of Potter Valley produced chromite from Red Mountain near Cummings in 1928, but he was away at the time the field work was done in the county, and the property was not visited.

Bibl: State Mineralogist's Report XIV, p. 420; Bull. 76, p. 151.

#### LIMESTONE.

*Northwestern Lime and Sulphur Company* has recently taken over land in Sec. 26, T. 17 N., R. 13 W., four miles northwest of Laughlin from the former owners, R. W. Crook, 423 California street, San Francisco, and G. W. Dutton and Frank Doyle of Santa Rosa. This company is said to be closely connected with the Northwestern Pacific Railroad Company. The limestone deposit is located on the ridge between Redwood Valley and Walker Valley. A crusher is to be installed at the quarry, and the limestone is to be hauled from this to a pulverizing plant at Laughlin station on the railroad. Three miles of new road is to be built from the quarry to the pulverizing plant. Capacity will be 50 tons per day. The lime is to be sold for treating agricultural lands to the south.

Another deposit of limestone of good quality is known to exist at point two miles north of Laytonville and a half mile to the east of the State highway. This deposit has not been developed.

#### MAGNESITE

Undeveloped magnesite has been reported from the ranch of James Vassar, 12 miles north of Cloverdale.

Bibl: State Mineralogist's Report XIV, p. 422.

#### MANGANESE

Considerable prospecting for manganese was done in Mendocino County during the war, and many claims were located. Description of these are to be found in Bulletin 76 of the California State Mining



bureau, 'Manganese and Chromium in California,' 1918. Properties that made substantial productions at that time are mentioned below. No manganese is being produced in the county at the present time.

*Busch and Bevins Manganese Mine* is located in Secs. 3 and 10, T. 7 N., R. 12 W., five miles northwest of Potter Valley. It is on the same ridge as the Thomas and Wild Devil mines. 2000 to 3000 tons of ore were produced here, and much low-grade ore remains, outcropping at intervals for several miles along the ridge.

Bibl: State Mineralogist's Report XVII, p. 145; Bull 76, p. 40.

*Independent Mine* is in Sec. 3 or 4, T. 18 N., R. 12 W., 14 miles by road east of Willits. Several thousand tons were produced here, in part by the Noble Electric Steel Company, and in part by the A. G. Suydam Company of San Francisco.

Bibl: State Mineralogist's Report XVII, p. 145; Bull. 76, p. 42.

*Thomas Manganese Mine* is in Sec. 27, T. 17 N., R. 12 W., six miles by good road northeast of Redwood station on the railroad. J. R. Thomas of Ukiah is the owner. 5000 tons running 50% manganese and 7-10% silica were taken out for the Noble Electric Steel Company during the war. Outcrops can be traced for more than a mile, the manganese showing along this distance at intervals but the work was done at the northern end of these showings. Considerable ore of a 10% grade was left in the workings, and higher grade ore was exposed in several places and not mined. The wall-rock is red jasper.

Bibl: State Mineralogist's Reports XIV, p. 421; XVII, p. 145; Bull. 76, p. 46.

*Wild Devil Manganese Mine*, located in Secs. 10, 15 and 16, T. 17 N., R. 12 W., to the north of the Thomas mine, made a small production for the Noble Electric Steel Company in 1916.

Bibl: State Mineralogist's Report XVII, p. 145; Bull 76, p. 48.

#### MINERAL PAINT

*Heughes Property.* A deposit of yellow ochre has been reported on the patented land owned by Mrs. Effie M. Heughes in Secs. 28, 33, T. 17 N., R. 12 W. Mrs. Heughes states that there is a manganese showing on the property also. No development work has been done.

Bibl: State Mineralogist's Report XVII, p. 146.

#### MINERAL WATER

*California Seltzer Springs* are located in the mountains of southern Mendocino County, twelve miles north of Cloverdale. The waters are carbonated and sparkling.

Bibl: State Mineralogist's Report XIV, p. 423.

*Duncan Springs* are in Sec. 25, T. 13 N., R. 12 W., one and a half miles southwest of Hopland. Both soda and sulphur springs occur here.

Bibl: State Mineralogist's Report XIV, p. 424.

*Gobbi Springs* are small undeveloped alkaline springs located at the base of the foothills, one mile west of Ukiah.

*Ornbaum Springs* are located in Sec. 7, T. 12 N., R. 13 W., 22 miles northwest of Cloverdale. More than twenty springs occur here, one of which is a highly carbonated soda spring that has been developed for the use of guests.

Bibl: State Mineralogist's Report XVII, p. 146.

*Orr's Springs* are in Sec. 24, T. 16 N., R. 14 W., 15 miles northwest of Ukiah. These springs are located in a beautiful section of mountainous country at an elevation of 1000 feet above sea level. At a distance of about a mile are the Montgomery redwoods, a fine grove of giant redwoods that are to be preserved as a national park. The resort is open to guests the year round; and the claim is made that the waters are effective in the treatment of various ailments, including rheumatism and kidney, liver and stomach troubles.

Bibl: State Mineralogist's Reports XIV, p. 423; XVII, p. 146.

*Vichy Springs* are located in Sec. 15, T. 15 N., R. 12 W., three miles east of Ukiah. The resort is kept open the year round, and is equipped with a plunge supplied with warm mineral water. Chemical analyses published in State Mineralogist's Report XIV show that these carbonated waters are very similar in composition to those at the following European locations: Ems on the Lahn, Fachingen of Nassau, Germany also Vichy of Grand Grille, France.

Bibl: State Mineralogist's Reports XIV, p. 423; XVII, p. 146.

#### NATURAL GAS

*Austin Muir*, Willits, has been using natural gas for many years from a well 200 feet deep on his place, three miles east of Willits.

#### NICKEL

*Bell Valley Mine.* W. Henry Williams of Upper Lake recently drove a prospect tunnel 15 or 20 feet on leased land in Sec. 4, T. 13 N., R. 13 W., near the road from Ukiah to Boonville and at a distance of 18½ miles from Ukiah. Sulphides in red and brown chert are said to have given returns in nickel but the showing is so small that it is unlikely that anything of importance will be developed. Nothing is being done at present.

#### PETROLEUM

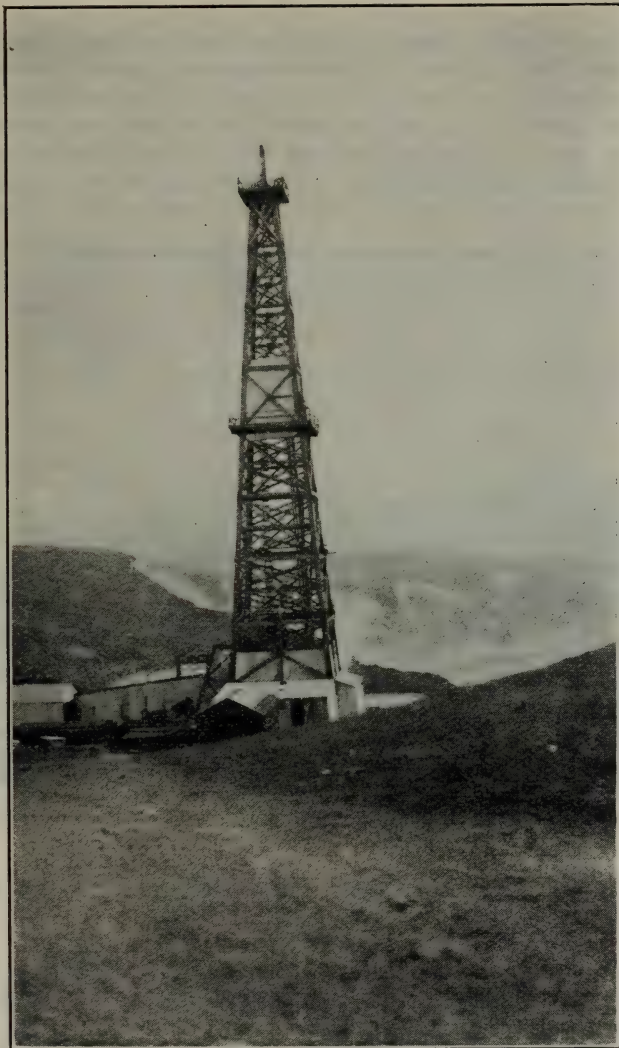
*Twin States Oil Company*, 415 Petroleum Securities Building, Los Angeles, controls a large acreage in T. 12 N., R. 16 W., T. 12 N., R. 17 W., T. 13 N., R. 16 W., and T. 13 N., R. 17 W., at Point Arena, and is drilling a well on these holdings.

This area has long been considered one of some promise for finding oil. The following is quoted from Bulletin 89 of the California State Mining Bureau, 'Petroleum Resources of California,' by Lawrence Vander Leek, 1921:

"In the vicinity of Point Arena, the Chico is overlaid by bituminous shales and some sandstone of what is probably the Monterey formation. This area of Monterey

covers about 25 square miles. \* \* \* Plate III is a reconaissance map of this area, showing structure and areal geology.

The Monterey formation is at least 5000 feet thick, the major portion of which consists of diatomaceous shale, of both the flinty and chalky varieties. \* \* \* Indications of petroleum are as follows: Along the sea cliffs, from the port of Point Arena as far north as the lighthouse, there are numerous seepages of dark asphaltic oil coming from fractured areas in the diatomaceous shale. Along the eastern flank of the syncline, corresponding to the O'Neal anticline and just southwest of the



Derrick of Twin States Oil Company, Pt. Arena, Mendocino County.

O'Neal ranch house, there is an outcrop of fine-grained bituminous sand about ten feet thick which can be followed in a northwest direction for  $3\frac{1}{2}$  miles, finally ending in the sea cliff, just east of the lighthouse. The sand is heavily bituminized and smells strongly of gasoline. It is possible that this deposit might be mined and distilled at a profit."

Then follow descriptions of several wells, the deepest of which was 2240 feet. This well was drilled in a syncline; and neither it nor any



of the others is considered to thoroughly test the formation. Continuing:

"The most favorable area for drilling in this district consists of about 400 acres in sections 10 and 11, T. 12 N., R. 17 W., M. D. B. and M. This area is on the axis of the O'Neal anticline. The structure is favorable and there is also the possibility of a drainage area from under the ocean. Seepages indicate that the fold contains some oil; but whether or not it is in commercial quantities can only be told by drilling."

The present well is about in the location just mentioned. At the time of visit, Oct. 4, 1929, it had reached a depth of 580 feet. Previously a depth of 700 feet had been reached; but trouble was experienced with junk in the hole at that point and it was necessary to cement the well in order to sidetrack this. The alignment of the hole was corrected at the same time. The rig is of the rotary type, and is capable of reaching a depth of 5000 feet or more with 11-inch casing,



Sea-cliff at Pt. Arena, showing dip of strata. Portion of derrick of Twin States Oil Company shows at extreme left.

if that depth is necessary to test the formation. 20-inch casing was used at the start.

#### PLATINUM

*Mendocino Mining and Milling Company, Inc.*, in 1920, erected an elaborate plant of 350 tons daily capacity to extract gold and platinum from a bed of gravel in Secs. 21 and 28, T. 13 N., R. 11 W., two miles east of Hopland. Values in gold and platinum are known to exist here in a bed of gravel  $1\frac{1}{2}$  to 3 feet thick, which has been described by Logan.<sup>1</sup> However, the plant was not a success; and it was shut down after one or two days' trial and later dismantled. In 1924, Lloyd C. Ashley of Alameda worked the deposit on a small scale for a while.

Bibl: State Mineralogist's Reports XVII, p. 147; XX, p. 87; Bull. 85, pp. 44-48.

<sup>1</sup> Logan, C. A., *Platinum and Allied Metals in California*, California State Mining Bureau, Bulletin 85, 1918.

## QUICKSILVER

*Occidental Mine* in Sec. 6, T. 12 N., R. 11 W., was worked 25 or 30 years ago. It has probably since been sold to the state for taxes. There are several other prospects in this vicinity.

## STONE INDUSTRY

*Mendocino County* produces gravel for road surfacing with the aid of a mechanical shovel; also produces river-run gravel from the Russian River with a dragline outfit. County equipment has recently been employed in widening and surfacing the road from Ukiah to Boonville.

*Northwestern Pacific Railroad Company* is a producer of gravel; also owns a rock quarry, which, however, has not been operated during the past year.

*State of California, Division of Highways*, produced crushed gravel recently near Laytonville; also purchased gravel from the following noncommercial producers: A. O. Peterson, Navarro; Ashurst Bros., Hopland; E. McPherson, Cloverdale.

*Ukiah Gravel and Cement Company*, John Freitas of Ukiah, owner, produces gravel from the Russian River. The product is washed and sized at a plant half a mile south of Ukiah. Four sizes are made, from sand to  $1\frac{1}{2}$ -inch; and the oversize from the river-run is crushed to pass the screens. A storage bin, about 30 by 12 by 10 feet deep, is divided into four compartments to hold the various sizes, and is provided with loading gates, under which trucks can be driven. A part of the product is used by the Healdsburg Pipe and Cement Company for making concrete pipe. Their plant for casting the pipe adjoins that of the Ukiah Gravel and Cement Company.

## LOS ANGELES FIELD DIVISION

By W. B. TUCKER and R. J. SAMPSON, Mining Engineers

## RIVERSIDE COUNTY

## Introduction.

Riverside County comprises a wide strip of territory stretching across the desert region of the southeastern part of the state from the Colorado River boundary westward to a terminus on the Pacific slope. In the county is the San Bernardino range, which separates the Mojave and the Colorado deserts and the county thus includes portions of both of these arid wastes. The principal summits of this range of mountains are San Bernardino and San Gorgonio, measuring respectively 10,630 and 11,485 feet in altitude. South of Beaumont is the San Jacinto Range which trends southeast, of which the principal peaks are San Jacinto and Tahquitz, measuring respectively 10,805 and 8825 feet in altitude.

The western portion of the county has become, with irrigation, one of the chief garden spots of southern California. Riverside is the fourth county in the state in size, has an area of 7240 square miles, and has a great variety of agricultural and mineral resources.

## Mineral Resources.

Riverside County's mineral resources include metals, structural and industrial minerals and salines, some of the more important being clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, soapstone and tin. In point of variety, Riverside County produced seventeen commercial minerals in 1927.

## METALS

The metals which have been produced in this county to be recorded in its statistics are copper, gold, lead, silver and tin. There are large deposits of iron in the county that could be mined successfully if industrial conditions were more favorable. Manganese is also known to occur in limited quantities.

## ANTIMONY

*Crowell Mine.* It is located five miles southwest of Corona. Elevation 1700 feet. Owner, J. Irving Crowell, Corona, California.

The ore, in the form of stibnite (sulphide of antimony), occurs in schist. The workings are caved.

Bibl: State Mineralogist's Reports XIII, p. 31; XV, p. 524.

## ARSENIC

Arsenic in the form of arsenopyrite occurs in the San Jacinto range of mountains and is also found in the Elsinore district.

*Shining Star Group.* Consists of three claims owned by Mr. James Wrench of Elsinore. They are located in Sec. 6, T. 6 S., R. 4 W., in the northwest corner of the town of Elsinore.

The country rock consists of slates and schists with intrusive dikes of felsites and felsitic porphyries. Along some of these contacts there



MINERAL PRODUCTION OF RIVERSIDE COUNTY 1893\*-1928.

Year	Gold value	Silver, value	Coal		Salt		Magnesite		Brick		Pottery clay		Lime and limestone		Miscellaneous stone <sup>1</sup> , value	Mineral water		Miscellaneous and unapportioned			
			Tons	Value	Tons	Value	Tons	Value	M.	Value	Tons	Value	Barrels	Value		Gallons	Value	Amount	Value	Substance	
1891																		125,289 lbs.	\$27,504	Tin.	
1892																		126,000 lbs.	32,400	Tin.	
1893	\$42,412																				
1894	93,322		7,891	\$16,142	1,981	\$3,962												50 tons	100	Gypsum.	
1895	285,106	\$2,550	7,050	15,000	4,000	8,000					3,700	\$4,230	24,000	\$19,200	\$24,000			18 tons	141	Gypsum.	
1896	262,800	13,450	4,982	9,964	4,317	8,634					7,700	9,400	10,000	10,000	27,955						
1897	147,227	4,000	6,282	15,705	4,840	9,680					22,019	22,750	20,000	6,000	17,000						
1898	189,188	1,384	6,200	15,000	5,000	10,000			500	\$5,800	9,500	10,450	8,000	7,000	8,000			6 tons	160	Mineral paint	
1899	163,010	2,000	7,905	19,762	3,600	7,200					11,700	11,250	15,000	6,000				10 tons	200	Asbestos.	
1900	149,292	6,848	6,000	15,000	4,000	8,000					9,500	10,450						30 tons	750	Asbestos.	
1901	109,747	2,150	2,800	7,000	4,000	12,000					14,900	16,800	13,476	13,476	8,850			1,000 tons	1,500	Glass sand.	
1902	47,947	94	1,200	3,000	20,000	20,000					20,000	10,450						50 tons	1,250	Asbestos.	
1903	13,453	136			10,000	20,000												200 tons	2,000	Glass sand.	
1904	7,488	80			15,000	15,000												110 tons	4,400	Asbestos.	
1905	35,090	346																500 tons	500	Glass sand.	
1906	4,432	251																300 tons	3,000	Gypsum.	
1907	3,836	26																100 tons	500	Gypsum.	
1908	5,884	112																12,000 cu. ft.	1,500	Marble.	
1909	186	24																5,000 cu. ft.	2,500	Marble.	
1910	5,585	28																20 tons	2,400	Bismuth.	
1911	20,623	2,121																( 2,500 cu. ft.	2,500	Marble.	
1912	20,202	254																	2,500	Gems.	
1913	12,501	104																	2,500	Gems.	
1914	10,000	100																3,000 cu. ft.	9,000	Marble.	
1915	10,760	1,522																50	Gems.		
1916	7,855	338																3,206 lbs.	170	Lead.	
1917																		502 lbs.	160	Copper.	
1918	392	1,541																10 tons	100	Asbestos.	
1919	213	415																22,665 lbs.	2,816	Copper.	
1920																		3 tons	300	Asbestos.	
1921																		400 tons	2,000	Gypsum.	
1922																		8,000 lbs.	1,016	Copper.	
1923																			877,192	Unapportioned, 1900-1909.	
1924	1,070	581																150 tons	1,500	Mineral paint.	
1925	3,687	2,570																	250	Gems.	
1926	2,931	3,135																6,753 lbs.	844	Copper.	
1927	1,492	1,919																800 tons	3,000	Glass sand.	
1928	2,180	1,503																920 lbs.	42	Lead.	
Totals	\$1,060,520	\$49,642	\$51,210	\$116,573	76,738	\$122,476	4,921	\$31,570										6,000 lbs.	900	Copper.	
																			3,532,857	Other minerals, 1910-1912.	
																			3,000	Gypsum.	
																			1,000 tons	1,000	Gems.
																			8,971 lbs.	1,391	Copper.
																				1,372,314	Other Minerals.
																			36,102 lbs.	4,802	Copper.
																			5,350 tons	7,825	Gypsum.
																				1,241,924	Other minerals.
																			3,450 tons	13,650	Gypsum.
																				1,022,814	Cement, potash, silica.
																			32,072 lbs.	1,507	Lead.
																			23,825 lbs.	4,169	Copper.
																			58,617 lbs.	14,420	Copper.
																			8,660 cu. ft.	4,800	Granite.
																			4,220 tons	8,340	Gypsum.
																			350 lbs.	24	Lead.
																			901 tons	1,024	Silica.
																				952,505	Cement, feldspar, magnesite, manganese, mineral water, potash.
																			28,838 lbs.	7,873	Copper.
																			11,097 tons	422,900	Feldspar.
																				3,461	Granite.
																			1,923 tons	3,001	Gypsum.
																			1,157 lbs.	100	Lead.
																			770 tons	2,400	Silica.
																				1,227,073	Cement, fluorspar, gems, magnesite, manganese, mineral water, potash, silver.
																			19,485 lbs.	4,813	Copper.
																			2,288 tons	11,733	Feldspar.
																				3,326	Granite.
																			3,791 tons	152,693	Manganese.
																			1,400 tons	4,800	Silica.
																				1,004,787	Cement, fluorspar, gems, gypsum, lead, magnesite, mineral water, potash.
																			10,590 lbs.	1,970	Copper.
																				17,975	Granite.
																			200 tons	425	Gypsum.
																			1,808 tons	49,324	Manganese ore.
																			3,034 tons	15,412	Silica.
																				2,103,760	Cement, coal, feldspar, fuller's earth, lead, magnesite, mineral water, potash.
																			1,094 tons		Feldspar.
																			6,168	26,408	Granite.
																			3,195 tons	12,581	Silica.
																				4,171,030	Cement, coal, gems, gypsum, mineral water, potash.
																			2,094 tons	14,808	Feldspar.
																				12,852	Granite.
																			1,625 tons	6,357	Silica.
																				3,927,493	Cement, coal, gems, potash.
																			1,087 tons	2,600	Feldspar.
																				30,210	Granite.
																				11,391	Silica (quartz).
																				2,059,806	Cement, coal, fluorite (optical).
																			5,000 tons	39,000	Feldspar.
																				24,778	Granite.
																				15,000	Silica (quartz).
																				5,367,282	Cement, coal, gems, gold, gypsum, silver.
																				1,116	Copper.
																				20,162	Feldspar.
																				17,680	Granite.
																				2,145	Lead.
																				26,817 lbs.	
																				24,579	Silica.
																				4,195,541	Cement, coal, gypsum, mica schist.
																				3,285	Copper.
																				16,090	Feldspar.
																				32,234	Granite.
																				11,821	Lead.
																				135,872 lbs.	Silica (quartz).
																				8,121 tons	Cement, coal, gypsum, mineral water.

\*Riverside County was created March 11, 1893, from portions of San Bernardino and San Diego counties.

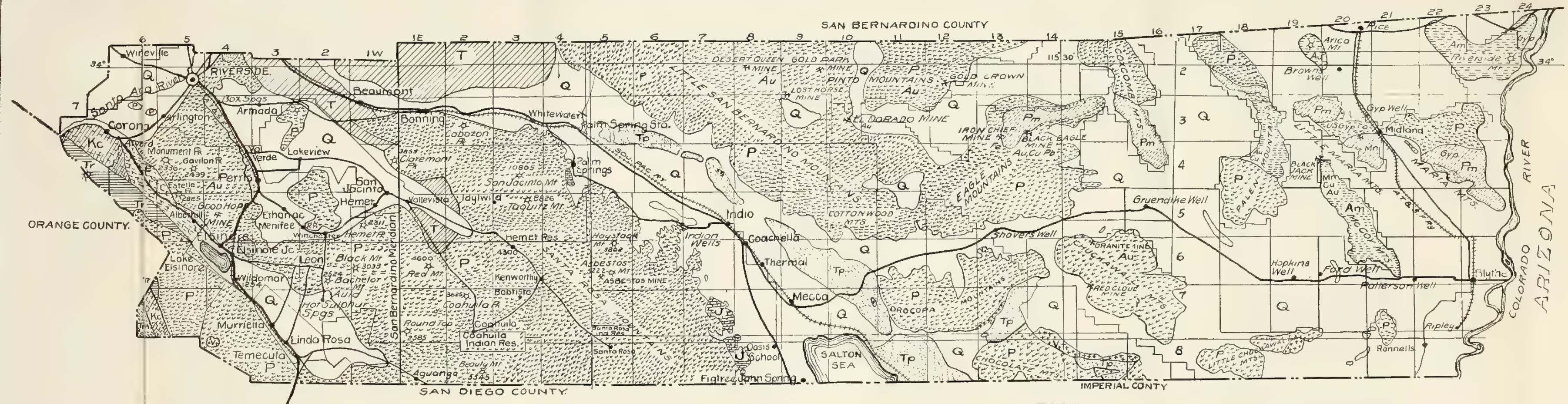
<sup>1</sup>Includes granite, crushed rock, gravel, sand, paving blocks.

\*Includes part of Los Angeles County.

Tons of limestone.

<sup>1</sup>See under 'Unapportioned'.





# GEOLOGICAL MAP OF RIVERSIDE COUNTY, CALIFORNIA.

TAKEN FROM U.S.G.S. WATER SUPPLY PAPER No. 497 AND GEOLOGICAL MAP OF STATE OF CALIFORNIA

~ APPROXIMATE SCALE ~  
0 8 16 24 MILES

## — GEOLOGICAL LEGEND —

- |  |  |  |   |  |  |   |   |   |   |  |   |
|--|--|--|---|--|--|---|---|---|---|--|---|
|  |  |  |   |  |  |   |   |   |   |  |   |
| Quaternary<br>Unconsolidated sands,<br>gravel, clays | Pliocene<br>Marine sands and<br>sandy shales, fresh-<br>water clays, marls<br>and gravel | Miocene<br>Heavily bedded ma-<br>rine sandstones, clay<br>shales and gravels<br>of lake origin | Eocene<br>Massive marine sand-<br>stones, with some shale,<br>swamp deposits, fresh-<br>water clays with some<br>coal | Tertiary (Undifferentiated)<br>Marine sandstones | Upper Cretaceous<br>Massive marine<br>sandstones, with some<br>shales and a few layers<br>of limestone | Jurassic<br>Slates and thin bed-<br>ded limestones with<br>some conglomerates | Triassic<br>Heavy thick-bedded<br>gray limestones and<br>thick masses of dark<br>siliceous slates | Paleozoic Metam-<br>orphic (Undifferentiated)<br>Crystalline limestones<br>slates and quartzite | Pre-Cambrian<br>Metamorphics<br>Gneiss, mica and<br>hornblende schist | Volcanics<br>Lavas, tuffs chiefly<br>andesites but includ-<br>ing some basalts<br>and small amounts<br>of rhyolite | Plutonics<br>Deep seated granitic<br>rocks, including granite,<br>diorite, granodiorite<br>and gabbro |



are veins filled with silicified wall rock, which are reported to contain arsenopyrite and some gold. The strike is N.  $25^{\circ}$  W. and the formation dips  $80^{\circ}$  to the west. It is reported that a sample from one of these veins two feet in width, assayed \$4.80 gold, 12% arsenic, 7% sulphur and 18% iron.

Development consists of two vertical shafts, one of which is 22 feet deep and the other 30 feet. Approximately 250 feet northwest of the 30-foot shaft and about 150 feet below its collar, a crosscut tunnel has been driven into the hill a distance of 75 feet. This tunnel cut five veins, ranging in width from one to two feet. Idle at the time of our visit.

#### COPPER

This metal is rather widely distributed in Riverside County but the principal deposits are situated in the eastern part of the county, in the McCoy, Maria and Palen mountains.

#### Mines.

*Anderson Group of Claims.* It comprises a group of claims located in T. 2 S., R. 12 E., S. B. M., about 30 miles northeast of Indio. Owner, Anderson and Company.

The country rock is granite and schist. The veins vary from two to six feet and strike northwest. The ore occurs as malachite and azurite. Development work consists of a shaft 80 feet in depth and a tunnel 100 feet in length. Idle.

Bibl: State Mineralogist's Report XV, p. 525.

*Badger State Group of Claims.* This group comprises 10 claims located on the east slope of the McCoy Mountains, about 20 miles northwest of Blythe. Owner, Harwood Robins, Riverside, California.

The country rock is porphyry and limestone. The ore occurs as oxides of copper in stringers in porphyry near the contact of the limestone. The ore, which occurs in the form of azurite and malachite, contains values in gold and silver.

The development consists of shallow shafts and opencuts. Idle.

Bibl: State Mineralogist's Report XV, p. 524; Bull. 50, p. 337.

*The Big Horn Group.* This group, consisting of 13 claims, is located in the Little Maria Mountains, eight miles west and four miles north of Inca siding on the Santa Fe Railroad. Elevation 1200 feet. Owner, E. E. Schellenger, Blythe, California.

In a belt of porphyritic rocks, approximately 300 feet wide, strike N.  $55^{\circ}$  E., dip  $30^{\circ}$  NW., there are several mineralized zones, which vary in width from 1 to 6 feet. The 'vein' filling is highly copper-stained and shows chrysocolla, some bornite and malachite. The 'vein' matter and the country rock adjacent to the 'veins' show a cellular structure. Frequently a network of quartz crystals is all that remains of the rock. This leached or vesicular condition exists to a greater or less degree throughout the porphyritic belt. Mr. Schellenger believes that this condition points to a secondary copper orebody below, which he believes will be found as a dissemination deposit in this rock. He reports that any of the porphyry will assay from a trace to 0.5% copper.



Development work consists of four shafts, 50, 25, 25, and 22 feet deep, respectively. Idle at the time it was visited.

*Crescent Group of Mines.* This group consists of five claims located in the north end of the McCoy Mountains, in Secs. 29 and 30, T. 4 S., R. 20 E., S. B. M., about 20 miles northwest of Blythe. Owner, Harwood Robins, Riverside, California.

The lode is from four to eight feet wide, occurring in schist. The ore is malachite and azurite, with some cuprite and chalcocite and also carries gold and silver values. The development consists of 3000 feet of tunnels and drifts.

Bibl: State Mineralogist's Report XV, p. 526.

*Electric Copper and Gold Mine.* This property, which is owned by Mrs. Chas. Carter, of Elsinore, consists of one patented claim, containing approximately 17 acres. It is located in Bundy Canyon, in Sec. 25, T. 6 S., R. 4 W., S. B. M., and is approximately five miles southeast of Elsinore, at an elevation of about 1500.

This deposit is on a contact between granite and schist. The contact, while quite irregular, seems to have a general strike of N. 10° W. and dips at 65° to the east. The values, which consist of copper, silver and gold, are reported to be distributed in the schist over a width of twenty feet from the granite, which forms the foot-wall. On the foot-wall side there is a zone which varies in width from two to six feet, and in which the values are somewhat higher than the average. The minerals observed were cuprite, impure (black) chrysocolla, chalcopyrite and pyrite. It is said that assays up to 36.5% copper, 22 ounces of silver and \$2 gold have been reported from composite samples taken across widths up to ten feet, but no information as to the general average is available.

Development consists of an incline shaft 60 feet deep. At the bottom of this shaft a crosscut was driven east a distance of 20 feet. From this point drifts were driven ten feet north and the same distance south.

At the time this property was visited, the shaft was full of water to within 20 feet of the surface. Idle.

*Fluor-Spar Group of Mines.* This group comprises three claims located on the west slope of the Palen Mountains, one mile southwest of Packard's Well and 30 miles northwest of Blythe. Elevation 1800 feet. Owner, Andrew Burleigh, New York.

The country rock is largely porphyry and limestone. The lode is 100 feet wide, strike northeast and southwest. The copper occurs as azurite, malachite and some cuprite, with gold and silver values. On these claims there are also deposits of fluorspar, iceland spar and silica.

Development consists of shallow opencuts. Idle.

Bibl: State Mineralogist's Report XV, p. 556; Bull. 50, p. 543.

*Homestake Mine.* It comprises 5 claims, situated on the east slope of the Palen Mountains, eight miles northwest of McCoy Springs and about 30 miles northwest of Blythe. Elevation 1600 to 2350 feet. Owner, Harwood Robins, Riverside, California.

The country rock is diorite-porphry and limestone. The lode is 50 feet wide, being mineralized with azurite and malachite, with gold

and silver values. The development consists of shallow shafts and opencuts. Idle.

Bibl: State Mineralogist's Report XV, p. 526; Bull. 50, p. 341.

*Mountain King Mine.* Comprises 3 claims on the east side of Ironwood Mountains, about 20 miles northwest of Blythe. Owner Harwood Robins, Riverside, California.

The ledge is 30 feet wide. The strike is northwest and southeast and the dip northeast. The country rock is porphyry and quartzite. The ore, which is azurite and malachite, contains besides copper, both gold and silver.

The development work consists of shallow shafts and opencuts. Elevation 1800 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 525; Bull. 50, p. 342.

*Nancy Copper Mine.* Property consists of 4 claims located one and one-half miles west of the Iron Chief Mine, in the Eagle Mountains. It is 17 miles east of Cottonwood Springs and 40 miles northeast of Mecca, a station on the Southern Pacific Railroad. Owner, George Lane, Mecca, California.

The quartz monzonite is cut by a series of parallel diorite dikes. The ore occurs on contact of diorite and monzonite. The principal development has been confined to a vein that strikes north and south and dips 70° W. This vein has an average width of four feet. The development consists of a shaft 130 feet, with drifts north and south on the 100-foot level. The ore is malachite, azurite, with some chalcopyrite. Samples taken from ore on dumps are stated to carry \$8 in gold, 6 oz. of silver and from 4 to 7% copper.

*St. John Mine.* It is located one and one-half miles south of Crescent Group of Claims, in the McCoy Mountains and 17 miles northwest of Blythe. The vein is 6 feet wide, strikes northwest and southeast. The country rock is schist.

The development consists of a shaft 75 feet deep. Some high-grade ore carrying 40% copper is reported to have been shipped from the property. Idle. Owner, R. L. Kennedy, Los Angeles.

Bibl: State Mineralogist's Report XV, p. 527.

#### GOLD

This metal is sparsely and widely distributed in Riverside County. The principal production has come from the region near Perris and Elsinore and the eastern desert area between the San Bernardino Range and the Colorado River.

Between 1876 and 1885 there was much active mining in the district about Elsinore and Perris and a considerable production of gold was made. The principal productive mines were the Good Hope, with a production record of about \$2,000,000, the Gavilan Mines, which had a substantial production, and the Santa Rosa Mine, located in the Pinate District, which produced considerable gold. At present writing there is not an active, operating mine in the Perris District, but some prospecting and development work is being done by the owners of claims in this area. The desert area of central and eastern Riverside



County is highly mineralized, and in many of the mountain ranges are exposed metalliferous veins carrying gold, copper and silver-lead. Gold is the more frequent metal in its occurrence and is found at many points, but there has been no great amount of production, principally due to the lack of sufficient water for milling purposes. At this time the most active districts are the Twenty-nine Palms, Virginia Dale and Eagle Mountains.

#### Mines.

*Anaheim Group of Claims.* It comprises 4 claims, situated in the Washington Mining District, about 8 miles south of Twenty-nine Palms. Owner, Edward Harman, Garden Grove, California.

There are two systems of veins on this group of claims. One has a course of N. 30° W., and dips 70° E.; the other system strikes east and west and dips 45° N. The width of the veins vary from 2 to 4 feet. The country rock is a granitic gneiss.

Development consists of a number of shafts from 50 to 100 feet deep. Two men employed.

*Alice Mine.* It is situated 4 miles south of Menifee, in the Pinacate Mining District. Elevation 1500 feet. Owner, J. S. Egan Estate, Perris, California. Idle.

Bibl: State Mineralogist's Reports XII, p. 221; XIII, p. 310; XV, p. 534.

*Alice Group of Mines.* This group of 6 claims is located in the Bendigo District, in Secs. 25 and 36, T. 1 S., R. 23 E., S. B. M., 6 miles south of Vidal. Elevation 1600 feet. Owner, Frank C. Adams, V. M. Osborne and F. C. Perew of Los Angeles.

The country rock is schist and limestone. The vein strikes northwest and southeast, occurring on the contact of schist and limestone. The vein quartz is mineralized with azurite and malachite and carries values in gold. The vein has a width of 4 to 6 feet.

Development consists of two tunnels, one 200 feet in length and the other 800 feet. There is a winze from the upper, 100 feet in depth. In 1914, 90 tons of ore, which had a value of \$50 per ton in gold and copper, was shipped to the smelter at Needles. Idle.

Bibl: State Mineralogist's Report XV, p. 544.

*The Ardanelle.* Consists of one claim, 3 miles southeast of Corn Springs, in the Chuckawalla Mountains. Elevation approximately 3000. Owner, A. Lederer, on the property.

It is reported that the vein, which is from a few inches to one foot thick, occurs on the contact of a felsite dike with a light-colored porphyritic country rock.

Development consists of open cuts and a 50-foot tunnel. Reported average values of \$10 in gold. Nothing but assessment work being done.

*Atlanta Mine.* Property is located in Sec. 1, T. 2 S., R. 9 E., S. B. M., in Gold Park Mining District, 9 miles from Twenty-nine Palms and 59 miles northeast of Palm Springs, a station on the Southern Pacific Railroad. Elevation 3400 to 3700 feet. Located as the *North Star Group* by J. Klugh of Pasadena, California, the present owner.



A narrow gash vein in granite strikes N. 10° E. and dips vertical. Development consists of a shaft 100 feet in depth sunk on the vein, which has a width of 12 inches. About 100 feet in elevation above the collar of this shaft there is a tunnel driven N. 10° E. for a distance of 250 feet. At 150 feet from the portal, a raise connects with intermediate tunnel. At 100 feet elevation is an upper tunnel driven 50 feet on the vein. A narrow shoot of ore 15 feet in length was exposed in the upper level. Idle.

Bibl: State Mineralogist's Report XVII, pp. 347-348.

*Bankers Group of Mines.* This group of claims is situated in the Chuckawalla Mountains, 4 miles west of Corn Springs. Owner, Jack Harvey, address unknown.

Bibl: State Mineralogist's Report XV, p. 540.



Twenty-nine Palms, Gold Park District, Riverside County.

*Bethel Mining and Leasing Company*, J. D. Anderson, secretary-treasurer, 3730 South Grand Avenue, Los Angeles; has 6 claims on the east slope of the Riverside Mountains, about 5 miles south of Vidal at an elevation of 1250 feet.

Quartz vein in schist. It has a north-south strike and dips 50° to the west; width of vein 2 to 6 feet. Vein is faulted about 20 feet below collar of the shaft.

Development consists of 100-foot incline shaft and about 400 feet cross-cutting to the north and east. This cross-cut is being driven in the hope of finding the faulted vein and also to cut two parallel veins, one of which is reported to be 2½ feet wide, and the other is one foot wide but carries high values. These veins are 300 feet and 550 feet east of the vein on which the shaft was started.

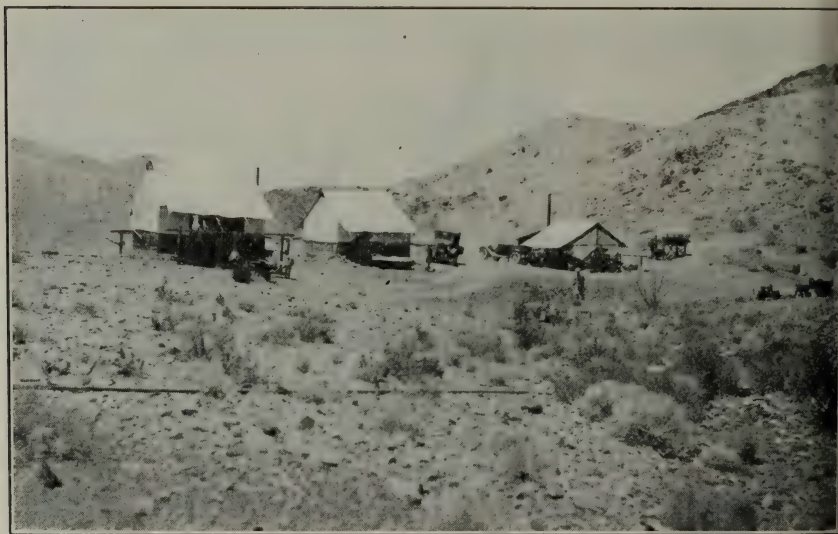
Equipment consists of 6-h.p. gasoline hoist and 85-cu. ft. air compressor which operates one jackhammer.

Three men employed driving crosscut.

*Black Eagle Mine* (lead-silver, copper, gold). It is situated in the northeastern part of the Eagle Mountains, 40 miles northeast of Mecca a station on the Southern Pacific Railroad. Elevation 2100 feet. Owner Black Eagle Mines, Inc., L. M. Clancy, president; W. S. Noblitt, secretary. Office, 505 Roosevelt Building, Los Angeles.

The property comprises 10 unpatented mining claims, known as Maleta Group. The Black Eagle vein courses through Maleta No. 1 and No. 2 claims, its strike being N. 70° W., with a dip of 85° N. At approximately the middle of Maleta No. 2, the vein intersects a cross vein which has been formed along a fault fracture. The intersection of these veins shows a mineralized fracture at least 15 feet in width. The Black Eagle vein occurs along the contact of quartzite and diorite forming a contact fissure.

Development: A shaft has been sunk on the vein to a depth of 21

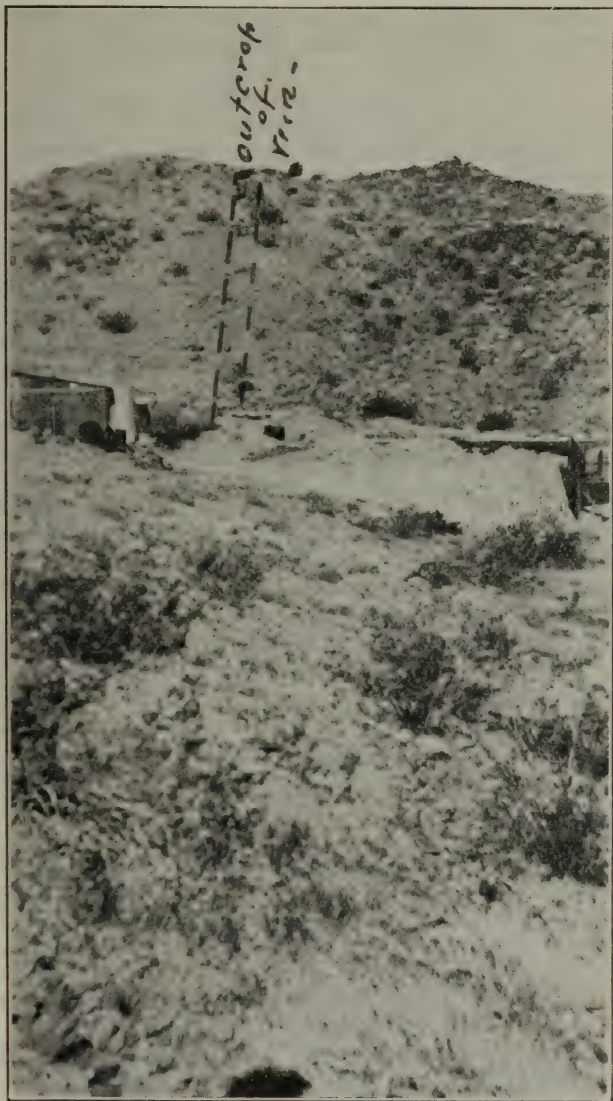


Camp of Black Eagle Mine, Eagle Mountains, Riverside County.

feet. An adit tunnel has been driven N. 70° W., for a length of 36 feet. This tunnel intersects the shaft 162 feet west of the portal and at a depth of 60 feet below the collar. At 35 feet below the tunnel level there is a level 100 feet in length on the vein. There is a small stope west of the shaft on this level from which 57 tons of ore were extracted and shipped. The 100-foot level is 95 feet below the adit level. Here the vein has been drifted on 240 feet west of shaft and 125 feet east. There is a small stope east of the shaft that extends to the intermediate level. On the 200-foot level, the vein has been drifted on 50 feet west. The orebody exposed on the above-mentioned levels is 150 to 200 feet in length and has an average width of 4 feet and is stated to have an average value of \$21 in gold, silver, lead and copper. The vein varies from 4 to 9 feet in width. Its filling is quartz, mineralized with galena, malachite, azurite, cuprite, anglesite, cerussite and lead vanadate.

## The mine run of ore assays:

Gold	-----	0.30	ozs.
Silver	-----	5.80	ozs.
Copper	-----	2	to 6%
Lead	-----	4	to 9%



Black Eagle Mine, Eagle Mountains, Riverside County.

## Ore shipments of sorted ore carried:

Gold	-----	0.53	ozs.
Silver	-----	16.00	ozs.
Copper	-----	5.70	%
Lead	-----	24.80	%
Insol	-----	55.00	%
Iron	-----	2.90	%



The total production of the mine is said to be \$30,000.

The property is equipped with a 6 by 8-in. Ingersoll-Rand compressor, driven by a 25-h.p. Fairbanks-Morse semi-deisel engine, which furnishes air for drills and running a Tugger air hoist at the shaft.

Mill equipment: The property is equipped with a 20-ton dry concentration plant, comprising a Blake crusher, bucket elevators, tromme screen, rolls and 2 Cottrell tables. The mill is driven by a 25-h.p. Fairbanks-Morse gas engine.

The mine run of ore was crushed to pass a 12-mesh screen. At this mesh the mineral contained in the quartz was not liberated from the gangue and the recovery made by dry concentration was very poor. The property was under operation from 1923 until the latter part of 1928. Idle.

Bibl: State Mineralogist's Report XX, pp. 193-196.

*Black Warrior Mine.* It is in Sec. 16, T. 2 S., R. 9 E., S. B. M., 12½ miles south of Twenty-nine Palms and 62 miles northeast of Palm Springs, a station on the Southern Pacific Railroad, in the Gold Park Mining District. Elevation 3550 feet. Owner, Wm. F. Keyes, Banning, California.

The formation is granite and gneiss. The mineralization occurs along a sheer zone in gneissoid-granite. The general trend of the ore-body is N. 10° W., with a dip to the west. The vein quartz is highly oxidized and contains considerable iron and manganese oxides. The vein is different from the other veins of the district, in that it contains considerable pyrite and some arsenopyrite.

Development consists of a shaft 200 feet deep. The shaft is vertical to the 70-foot level, from which point it is sunk on an incline of 65°. On the 70-foot level, there is a drift 90 feet in length. On the 150-foot level, a crosscut was run 60 feet west which is said to be entirely in ore. The vein has a width of 60 feet.

Equipment consists of a 12-h.p. Western gas engine hoist, one 6 by 8-in. Chicago pneumatic compressor. Idle.

Bibl: State Mineralogist's Report XVII, p. 348.

*Boss Mine* (now located as the *Goat Basin*). It is situated in Sec. 1, T. 2 S., R. 9 E., S. B. M., in the Gold Park Mining District, 9 miles south of Twenty-nine Palms and 59 miles northeast of Palm Springs, a station on the Southern Pacific Railroad. Elevation 3500 feet. Owner, Wm. F. Keyes, Banning, California. Holdings comprise one claim.

The vein strikes north and south. The hanging wall is granite with a diorite footwall. It varies in width from 2 to 4 feet.

Development consists of a vertical shaft 122 feet deep. At the bottom of the shaft there is a drift north 200 feet. Total amount of underground workings amounts to 1000 feet of crosscuts and drifts. All equipment removed from property. Idle.

Bibl: State Mineralogist's Report XVII, p. 347.

*Brown Mine.* It is located in Sec. 7, T. 2 S., R. 10 E., S. B. M., about 6 miles west of Blythe Junction, at an elevation of 1500 feet. It adjoins the Gray Mine on the north and south. The vein strikes N. 20° W. and occurs in schist. The width of the vein varies from 6

inches to 2 feet. There is a 3-stamp mill on the property. Owner, Floyd Brown, Blythe, California. Idle.

Bibl: State Mineralogist's Report XV, p. 542.

*Bryan Mine.* It consists of 2 patented claims located 2 miles south of Corn Springs, in the Chuckawalla Mountains. Owner, J. M. Huston, Los Angeles. Operated from 1898 to 1900 by Adams and Pickering, the ore being treated in a 2-stamp mill at Corn Springs. Idle.

Bibl: State Mineralogist's Report XV, p. 539.

*Calzona Mines.* Holdings comprise 12 claims, located in Secs. 31, 36, T. 1 S., Rs. 23, 24 E., S. B. M., in the Bendigo Mining District,  $6\frac{1}{2}$  miles southeast of Vidal. Former owner, Calzona Mines Company, Redlands. Reported to have been taken over by C. W. Mitchell, Parker House, Boston, Massachusetts.

The vein occurs on a contact of schist and limestone. The ore is oxidized gold and copper ore. Shipments made to the smelter are said to have brought \$60 per ton.

Development consists of a tunnel 800 feet long and a 200-foot shaft, with 2000 feet of drifts and crosscuts. Idle, but expect to resume work, according to reports, in October, 1929.

Bibl: State Mineralogist's Report XV, pp. 542-543.

*Desert Queen Mine.* Comprises 5 claims in Sec. 5, T. 2 S., R. 8 E., S. B. M., 45 miles northeast of Palm Springs, a station on the Southern Pacific Railroad. Elevation 4250 feet. Owner Wm. F. Keyes, Banning, California.

A narrow quartz vein occurs in the granite following a porphyry dike. The strike of the vein is north and south, with a dip of  $20^{\circ}$  to the east. The width varies from a mere stringer to 14 inches. The ore is free-milling and the gold is often visible to the eye.

Development consists of a number of tunnels from 50 to 300 feet in length, driven at different elevations; opencut 200 feet in length by 50 feet wide and 15 feet in depth; total amount of drifts and crosscuts being about 2000 feet.

Mill equipment consists of Blake type crusher, 20-ton Herman Ball mill; Wilfley table. The plant is driven by a 12-h.p. gas engine. The property was operated during 1921. Idle.

Bibl: State Mineralogist's Report XIII, p. 310.

*Dos Palmas Group of Claims.* These claims are located in the Palo Verde Mountains, 18 miles north of Dos Palmas. Idle.

Bibl: State Mineralogist's Reports XII, p. 221; XV, p. 541.

*Fish Mine.* It is located 12 miles northeast of Salton. Elevation 1000 feet. Owner, A. C. Fish, San Bernardino, California.

Bibl: State Mineralogist's Reports XII, p. 221; XIII, p. 311; XV, p. 541.

*Free Coinage and Charity Mines.* These claims are located 5 miles north of Canyon Springs and 12 miles northeast of Dos Palmas.

Bibl: State Mineralogist's Reports XII, p. 221; XIII, p. 311; XV, p. 541.

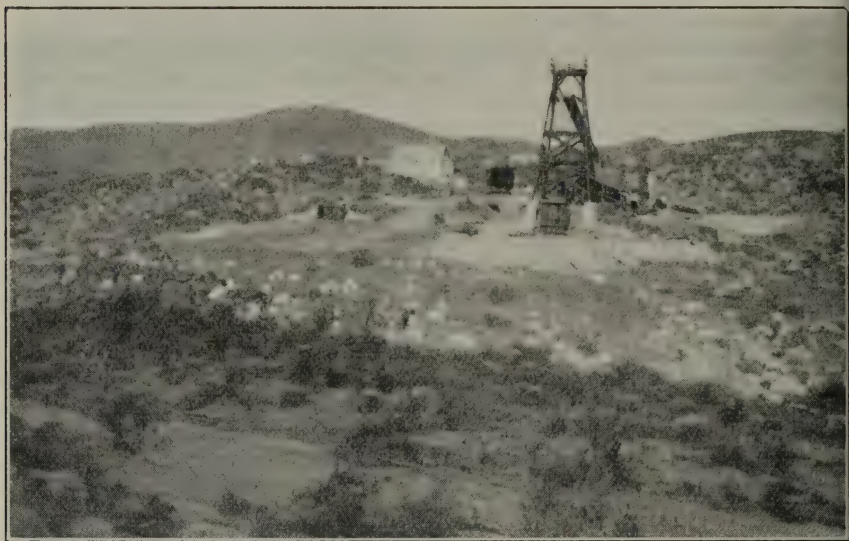
*Gavilan Mines.* These mines are located 6 miles west of Perris, on the old Rancho Sobrante de San Jacinto. Idle.

Bibl: State Mineralogist's Reports XI, pp.334-337; XIII, p. 311; XV, p. 528.

*Gold Coin Mine.* It comprises 5 claims, located in the Pinon Mining District, about 25 miles northeast of Indio. Owner, F. C. Longnecker, Los Angeles.

A series of parallel veins occur in granite, with a general east and west course. Average value of the ore is reported to be \$12 per ton. Development consists of shaft 50 feet deep. Two men employed.

*Gold Crown Mine (Bon Ton).* Property comprises 25 claims located in Secs. 15 and 16, T. 2 S., R. 12 E., S. B. M., in the Dale Mining Dis-



Gold Crown Mine, Dale Mining District, Riverside County.

trict, 10 miles west of Twenty-nine Palms. Elevation 2000 feet. Owner, George A. Novelle, 502 Pacific Mutual Building, Los Angeles.

The gold Crown vein has a trend of N. 20° W. and dips 75° to the west. The vein occurs in granite and has an average width of 4 feet, with 2 feet of quartz on the footwall. At intervals along the outcrop the vein has been developed by four shafts with depths varying from 40 to 150 feet. The principal development has been confined to a double compartment shaft sunk on the vein to a depth of 150 feet. About 100 feet north of this shaft, there is another shaft sunk on the vein to a depth of 100 feet. Samples taken from the vein in these two shafts show an average value of \$12 per ton. There is also a series of parallel veins striking N. 50° E., that intersect the Gold Crown vein north of the main shaft. These veins vary in width from 12 inches to 2 feet. It is reported that samples taken along the outcrop show an average value of \$20 to \$40 per ton.

About 2000 feet southeast of the main shaft on Gold Crown No. 12 claim, a shaft has been sunk on a vein that strikes N. 15° W., and



ps 80° E. The vein width is 12 inches. Both walls are granite. The matrix is stained with copper oxides. The average value of the ore is said to be \$16 per ton in gold with .03% copper.

Development consists of a shaft 180 feet deep, sunk on an inclination of 80°. Short drifts have been run on the vein, both north and south, at the 40, 80 and 130-foot levels. About 30 feet west of these workings there is a parallel vein which has been exposed by a shaft 20 feet deep. This vein has a width of 6 inches.

Mine equipment: A 25-h.p. single-drum gasoline-driven hoist; 9 by 14 in. Ingersoll-Rand compressor; Leyner drill sharpener.

Mill equipment consists of 2 Nisson stamps, weight 1800 pounds per stamp and Blake crusher. Water is secured from a well located at Old Dale, 9 miles from the mine. The well is 95 feet deep, and has an average flow of 50 gallons per minute. Pump equipment consists of an American centrifugal pump driven by 25-h.p. Fairbanks-Morse diesel motor. The pump has a capacity of 75 gallons per minute. At the pumping plant there is a concrete storage tank, having a capacity of 20,000 gallons. The concrete storage tank at the mine has a capacity of 18,000 gallons. Two men are employed.

*Gold Dollar Group of Mines.* Group comprises 19 claims located in Secs. 35 and 36, T. 1 S., R. 23 E., 5 miles south of Vidal. Elevation 700 feet. Owner *Riverside Gold Mining and Milling Company*, J. W. Fare, president, 363 Orizaba avenue, Long Beach, California.

The principal development is confined to Gold Dollar No. 1 and Gold Dollar No. 2 claims. There is a series of parallel veins. The principal vein occurs on a contact of limestone and schist. The widths of the veins vary from 1 to 10 feet. The ore is oxidized gold-copper ore, carrying about 4% copper, with gold and silver values.

Development consists of an upper tunnel, which is a crosscut 65 feet to the vein, with a drift 250 feet on the vein. About 350 feet vertically below this tunnel is another adit tunnel driven on the vein for a distance of 430 feet. In the upper tunnel the orebody developed is said to be 120 feet in length. A winze 60 feet in depth has been sunk in this ore shoot from the upper tunnel. It is stated that 150 tons of ore shipped to the smelter gave returns of \$40 per ton. Idle.

Bibl: State Mineralogist's Report XV, p. 544.

*Golden Chariot Mine.* It is located in the Pinacate District, 5 miles northwest of Perris, adjoining the Santa Rosa Mine on the southwest. There is a shaft 310 feet deep. Idle.

Bibl: State Mineralogist's Report XIII, p. 311.

*Gold Galena Mine.* Comprises 9 claims, located in Secs. 4, 5 and 9, T. 3 S., R. 9 E., S. B. M., in the San Bernardino Mountains, about 20 miles northeast of Indio. Owner, F. C. Longnecker, of Los Angeles.

Bibl: State Mineralogist's Report, XV, p. 538.

*Gold Hill Mine.* It comprises 5 claims located 6 miles east of Keys' Ranch and 12 miles south of Twenty-nine Palms, in the San Bernardino range of mountains. Owners, C. H. Wiser, Anvil B. Johns, Rialto, California, and J. A. Johns, San Bernardino, California.

A series of parallel veins occur in the granite. The general trend of these veins is north and south.

Development consists of a series of shallow shafts. Idle.

*Golden Rule Group of Claims.* Consists of 2 claims located in the Washington Mining District, 8 miles south of Twenty-nine Palms Owners, Dr. Francis Coltrin, E. C. Miles and John Stull, Fullerton California.

The vein occurs in gnessoid-granite, with a trend of N. 30° W. and dip 80° W. The width varies from 12 inches to 2 feet. A diorite dike occurs along the footwall of the vein.

Development consists of a shaft 75 feet deep sunk on the vein. At a depth of 50 feet there is a drift south 35 feet. Two men are employed in sinking a shaft.

*Golton Group of Claims.* This group consists of 15 claims in Sec. 20 T. 5 S., R. 4 W., S. B. M. They are 4 miles northeast of Elsinore and 2½ miles southwest of the Good Hope Mine. Owner, Fred Golton of Elsinore, California.

The rocks in the southwest portion of the property are slates and schists. A porphyritic belt which appears to have a maximum thickness of about 2000 feet, is in contact with these rocks on the northeast. There are numerous dikes of fine-grained granite, diorite and felsites. The mineralization is confined to the various contacts and the dike rocks. Where the igneous rocks are in contact with the slates, considerable tourmaline is present and in places it resembles the tin stone of the Temescal District.

Development work consists of opencuts and a few short tunnels. Practically all of this work has been done in the porphyritic belt. At the bottom of a 10-foot shaft it is reported that a streak 2 feet wide assays 0.32 ounces in gold and 6.0 ounces in silver.

Only assessment work now being done.

*Good Hope Mine.* It is situated in the NW¼ of Sec. 15, T. 5 S. R. 4 W., S. B. M., 4½ miles southwest of Perris, in the Pinacate Mining District. The veins occur in the granite, strike N. 14° E., and dip 65° W. Idle.

Bibl: State Mineralogist's Report VIII, p. 527, IX, p. 151; XI, p. 106; XII, p. 221; XIII, p. 311; XV, pp. 532-533.

*Granite Mine.* This mine is in the Chuckawalla Mountains in Sec. 35 T. 5 S., R. 15 E., S. B. M., 3 miles south of Desert Center and 50 miles west of Blythe. Owner, *Chuckawalla Mining and Milling Company* A. G. Karpe, president, Haas Building, Los Angeles.

The vein is associated with a fine-grained dike in granite, and strikes N. 10° W. and dips 50° W.

Development consists of an elaborate system of tunnels, a large part of which were driven on a pegmatite dike in the granite. A crosscut tunnel driven west intersected the vein at approximately 600 feet from the portal. Approximately 400 feet north of this point an air shaft was driven to the surface on the vein. It is reported that some stoping was done and that some good ore was encountered.

There is a 20-ton mill on the ground, consisting of a 3-foot ball mill 3- by 8-foot amalgamating plate; a concentrating table and 2 cyanide leaching tanks. The mill is driven by a 15-h.p. gasoline engine. Idle.

*Gray Mine* (Priest). Property comprises a group of 10 claims, located in Sec. 7, T. 2 S., R. 20 E., S. B. M., in Arica Mining District, six miles southwest of Blythe Junction (Rice). Former owner, *Assets Realizing Company*, Los Angeles. The property was operated by this company from 1909 until December 1, 1912, when operations were suspended. E. E. Schellenger, of Blythe, has relocated and now holds the Arica claim and Henry Hartman, of Blythe, has the Big Butte claim. The vein strikes N. 20° W. and dips 25°. Its width is from 12 inches to 2 feet. The country rock is schist. The ore is free-milling for a depth of 150 feet and is said to have an average value of \$8 per ton. Below the 150-foot level the vein quartz is heavily mineralized with pyrite.

Development consists of a 340-foot vertical shaft with 700 feet of drifts and crosscuts on the 300-foot level. A winze has been sunk from the 300-foot level to a depth of 229 feet with 300 feet of drifts and crosscuts on the different levels from the winze.

Equipment consists of one 60-h.p. Fairbanks-Morse gas engine hoist and Sullivan compressor. Mill equipment consists of 10-stamp mill and cyanide plant. Idle.

Bibl: State Mineralogist's Report XV, pp. 541-542.

*Happy Jack Mine*. It is located one mile southwest of Corn Springs. Owners, Dr. Wood, Long Beach, California, and H. T. Seward, Los Angeles. Idle.

Bibl: State Mineralogist's Report XV, p. 540.

*Hemet Belle Mine*. This is located in Sec. 31, T. 6 S., R. 4 E., S. B. M., in the San Jacinto Forest Reserve, 25 miles northeast of Hemet. E. E. Chilson Estate, of Kenworthy, owner. Idle.

Bibl: State Mineralogist's Report XV, p. 535.

*Hexahedron Mine*. Located in the Pinon Mountain District, 25 miles northeast of Indio. Owner, *Indio Mining and Milling Company*, J. S. Garrison, president, Victorville, California.

The ore is in a mineralized felsite dike which strikes east and west. The ore-shoot which was 75 feet long and 15 to 20 feet wide dips 45° N. Dead, and mill has been dismantled.

Bibl: State Mineralogist's Reports XII, p. 223; XIII, p. 311; XV, p. 536.

*Hodges Mine*. It is in the Hodges Mountains about 8 miles west of Ripley, which is 9 miles southeast of Blythe. Owner unknown.

Formerly operated by Hodge Bros., who had a 3-stamp mill at Palo Verde. Taken over by Mr. Ludden of Pomona, who added two stamps and moved the mill to the mine. Water was pumped from a well in the valley  $3\frac{1}{2}$  miles away. Operations continued until 1913, when the property definitely shut down. No further information is available.

*Huff and Lane or Lone Star Group*. Consists of 21 claims in the Pinto District in T. 2 S., R. 12 E., 42 miles northeast of Mecca. Elevation 1200 feet.

Owners, E. C. Huff, 823 South Bonnie Brae Street, Los Angeles, and George Lane, Mecca, California. Discovered by Lane in 1887.



Veins are in a granite formation. A 60-foot shaft, sunk on a north-south vein has 30 feet of drifting at the bottom. The vein is from 2 to 4 feet wide and is reported to average \$15 in gold.

At 600 feet north of the shaft this vein is intersected by an east-west vein which is 5 feet wide and dips  $80^{\circ}$  to the north. On the hanging wall side of this vein there is a diorite casing. Values are reported to average \$6 per ton in gold. Minerals in the veins are pyrite and chalcopyrite stained with azurite and malachite.

There is a 20-ton ball mill and amalgamation plates on the property. Water is supplied from a well which is 600 feet deep and is lined with 7-in. casing.

They are now sinking the shaft deeper. Six men are employed.

*Indian Queen Mine.* It is in the NW $\frac{1}{4}$  Sec. 32, T. 4 S., R. 4 W.,  $4\frac{1}{2}$  miles west of Perris.

Bibl: State Mineralogist's Report XIII, p. 311, XV, p. 531.

*Ingersoll (Ramona).* Is 50 miles northeast of Walter's Station in the Monte Negras District. Former owners, Elser, Ingersoll et al., of San Bernardino, California. Present owner unknown.

Bibl: State Mineralogist's Reports XIII, p. 311; XV, p. 538.

*Iron Chief Mine.* Property comprises 6 claims in T. 3 S., R. 14 E., S. B. M., in the Eagle Mountains, 45 miles northeast of Mecca. Elevation 2500 feet. Owner, *Southern Pacific Company*.

It is a replacement deposit which occurs on a contact of limestone and quartz-monzonite. The replacement zone averages 6 feet in width and is filled with hematite and quartz. This iron gossan carried \$10 per ton in gold to a depth of 140 feet, where the sulphide zone was encountered. Minerals in sulphide zone are pyrite and chalcopyrite, carrying gold values. The strike is N.  $70^{\circ}$  W. and the dip  $45^{\circ}$  N.

Development consists of a vertical shaft 140 feet deep which is intersected at the 100-foot level by a 500-foot crosscut tunnel. At this level 500 feet of drifting in ore was done, this being the length of the ore-shoot. The shoot was stoped to the surface over a length of 300 feet.

Equipment consists of 25-h.p. gasoline hoist, head frame, blacksmith shop, assay office, 25-ton ore bin, 2 jaw crushers, one set of rolls, and 8 cyanide vats 18 by  $4\frac{1}{2}$ -ft.

Production \$150,000. Idle.

*Jackknife Group.* Consists of 11 claims in Sec. 1, T. 2 S., R. 23 E., and Sec. 6, T. 2 S., R. 24 E., S. B. M., about 6 miles southwest of Vidal. Elevation 1200 feet. It is reported that C. W. Mitchell, Parker House, Boston, Massachusetts, has taken over this mine, together with the Calzona and Steece properties.

The value of gold and copper are in pockets along a contact of limestone and schist. Strike N.  $55^{\circ}$  E. and dip about  $50^{\circ}$ .

Bibl: State Mineralogist's Report XV, p. 543.

*Jumbo Mine.* It is 5 miles west of Perris at an altitude of 2200 feet. A small vein strikes N.  $10^{\circ}$  W. and dips  $80^{\circ}$  W. Opened by a 50-foot shaft. Idle.

Bibl: State Mineralogist's Reports XIII, p. 312; XV, p. 530.

*Justice or Colorado.* Is 4 miles west of Perris in Sec. 32, T. 4 S., R. 4 W., S. B. M. Small vein of high grade quartz. Idle.

Bibl: State Mineralogist's Reports XIII, p. 310; XV, p. 531.

*La Rica Mine.* It consists of one claim which is 7 miles west of Rancho in Hodges Mountain. Owner, Pete Daniel, Blythe, California. Reported a 15-in. quartz vein in granite. Strike is east-west, dip practically vertical. Development consists of open cuts and 40-foot tunnel. Idle.

*Leon Mine.* It is on the Briggs Ranch, 14 miles southeast of Perris. Idle.

Bibl: State Mineralogist's Reports XII, p. 223; XIII, p. 312.

*Little Maggie Mine.* It is 4 miles west of Perris. The vein strikes north and dips 45° S. Idle.

Bibl: State Mineralogist's Reports XII, p. 223; XIII, p. 312.

*Little Pete Mine.* It is 4 miles west of Perris. Owner unknown. Small east and west vein, carrying arsenical pyrites. Idle.

Bibl: State Mineralogist's Reports XIII, p. 311; XV, p. 531.

*Lost Horse Mine.* This property comprising 13 acres, patented, in Sec. 31, T. 2 S., R. 9 E., S. B. M., in the Pinon Mountain District, 28 miles northeast of Indio. Elevation 5000 feet. Owner, T. C. Ryan, Los Angeles.

The vein, varying in width from 6 inches to 5 feet, occurs in a laminated, micaceous quartzite. The strike of the country rock is north and south, while that of the vein is east and west. Vein dips 30° N.

Developed by a 500-foot shaft, 50-foot winze, 50-foot drift and 50-foot tunnel. About \$350,000 was produced with a 10-stamp mill, from a good grade of ore.

Bibl: State Mineralogist's Reports XII, p. 223; XIII, p. 312; XV, p. 536.

*Liberty Group.* It consists of 4 claims, Liberty, 1, 3 and 4 and the Rainbow, in Red Cloud Canyon, in the Chuckawalla Mountains. Owner, J. Lederer, Corn Springs, California.

It is reported that there are 3 or 4 quartz veins which occur on the contact of rhyolite porphyry dikes with granite gneiss. They vary in width from 4 to 20 feet and are traceable for a mile. Average value reported to be about \$6 per ton. It is a part of the old Red Cloud Group.

Development consists of open cuts and one tunnel, the face of which is reported to show 4 feet of \$30 ore. Idle, except that assessment work is being done by the owner.

*Louise Mine.* Consists of one claim situated in the Dale Mining District, one mile due west of the Gold Crown Mine, and 10 miles west of Twenty-nine Palms. Elevation 2000 feet. Owners, Jack Meek and J. Evans, Twenty-nine Palms, California.

The vein occurs in granite with a trend of N. 20° W., and dips 80° N. It has an average width of 2 feet. The vein quartz is mineralized

with galena, chalcopyrite and shows free gold. Samples taken across the vein are stated to carry gold 6.6 oz., silver 5.4 oz., lead 8.8%.

Development work consists of three shallow shafts about 8 feet deep. Two men are employed in sinking a shaft.

*Lucky Boy (Walker) Claim.* It is on the Walker Ranch, 2 miles south of Menifee.

A narrow, heavily mineralized vein much broken and faulted, has not had sufficient work done on it to make any estimate of its value possible. Idle.

Bibl: State Mineralogist's Reports XI, p. 385; XII, p. 223; XIII, p. 312; XV, p. 534.

*Mammoth Mine.* It is 9 miles south of Perris, in Sec. 8, T. 6 S., R. 3 W., S. B. M., at an elevation of 1600 feet. Owner, A. A. Adair, Riverside, California.

A quartz vein in grano-diorite averages 7 feet in width, strikes north east and dips  $15^{\circ}$  to the northwest. It is impregnated with pyrite and shows free gold.

Development consists of a 200-foot incline shaft. Idle.

Bibl: State Mineralogist's Reports XIII, p. 312; XV, p. 534.

*Meek Claims.* Consists of 2 claims, the Earnie and the Melville located in Sec. 1, T. 2 S., R. 23 E., S. B. M., adjoining the Jackknife Group. Owners, Messrs. Meek and Sass, Los Angeles.

Bibl: State Mineralogist's Report XV, p. 544.

*Menifee Mine.* This property is about 8 miles south of Perris at an elevation of 1500 feet. Owner, Tom Chaffin, at the mine.

A quartz vein, gold-bearing in places, occurs between a hanging wall of diorite and a chloritic schist footwall. Beyond the schist, diorite is again encountered.

Development consists of 4 shafts, 30, 55, 100 and 125 feet in depth.

The quartz is said to have milled about \$15 per ton and to contain but a small percentage of sulphides. Was equipped with a steam hoist and a 5-stamp mill. Idle.

Bibl: State Mineralogist's Reports XI, p. 385; XIII, p. 312; XV, p. 533.

*Messenger Mine.* This property is in the Iron Chief Group of claims in the Eagle Mountains, 40 miles northeast of Mecca. Owner, W. H. Bradley, Boyle Heights, Los Angeles.

The vein is from 3 to 4 feet wide. From the 100-foot shaft, 50-foot drifts have been run north and south. Idle.

Bibl: State Mineralogist's Reports XIII, p. 312; XV, p. 541.

*Mildred-Allen Group of Claims.* This group comprises 4 claims situated in the Washington Mining District, 7 miles south of Twenty-nine Palms. Owners, Fred Jensen and John North, Huntington Beach, California.

A series of parallel quartz veins occur in granite-gneiss. Their trend is N.  $30^{\circ}$  E., and dip  $80^{\circ}$  S. to vertical. Width of the veins varies from 12 inches to 3 feet.



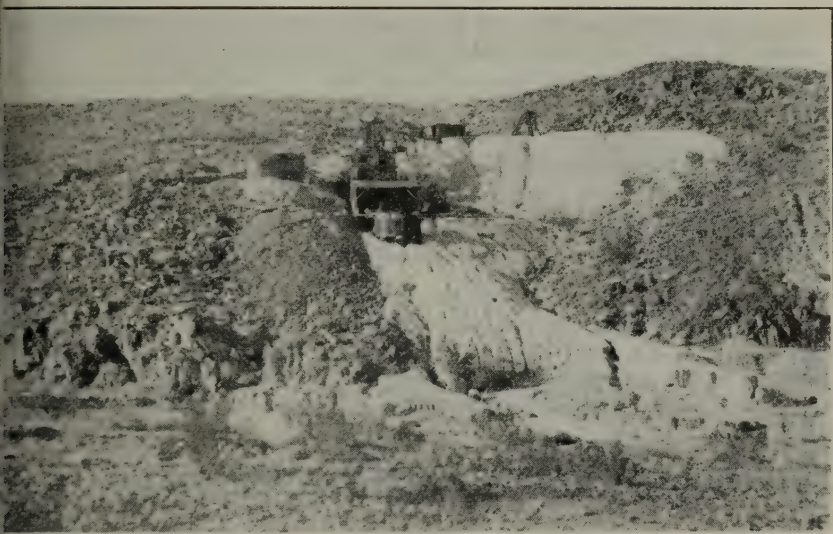
Development consists of a tunnel driven S. 30° W., 20 feet, and a size 65 feet deep on the most westerly vein. On the southwest section of these claims, a shaft is being sunk on a vein which has a width of 12 inches. Sorted ore from these workings is reported to carry from \$12 to \$40 per ton in gold. Two men are employed.

*Missing Link* (Virginia-Shay). It is 6 miles west of Perris, in NE $\frac{1}{4}$  Sec. 32, T. 4 S., R. 4 W., S. B. M. Owner, Hugh Duff, 626 Wesley Roberts Building, Los Angeles.

Several holes on a vein (which is said to have carried considerable value) are now flooded and inaccessible.

Bibl: State Mineralogist's Reports XIII, p. 526; XI, p. 385; XII, p. 225; XIII, p. 313; and XV, p. 532.

*Morning Star Mining Company* has 3 claims 1 $\frac{1}{2}$  miles southwest of Horn Springs in the Chuckawalla Mountains. Elevation 1800 feet.



New El Dorado Mine, Pinon District, Riverside County.

Varner Graves and Mr. Blair, of Imperial County, are officers of the company, which is not incorporated.

It is a quartz vein in granite. A crosscut tunnel is being driven to intersect the vein. This tunnel is now in about 150 feet. Two men are employed.

*New El Dorado Mine.* It is in Sec. 17, T. 3 S., R. 10 E., S. B. M., in the Pinon Mining District, 20 miles northeast of Indio and 19 miles south of Twenty-nine Palms. Holdings comprise 3 claims of which one is patented. Owner, Fred Vaile, Los Angeles. Under lease to John White, San Bernardino, California.

The El Dorado vein occurs in granite-gneiss, with a general north-south course and dips 70° E. Width 5 to 6 feet with no well-defined walls. Vein quartz is mineralized with galena and lead vanadate.

Development consists of a shaft 500 feet deep, sunk on the vein. The vein has been drifted on north on the 100-, 200-, 300-, 450- and 500-ft levels. Present development is confined to 450- and 500-ft levels.

Mine equipment consists of 15-h.p. gas engine hoist. Mill equipment consists of ten 1000-pound stamps and Wilfley concentrator, driven by a 25-h.p. gas engine.

Three men employed.

*Ophir Mine* (Lucky Strike). It is 6 miles southwest of Perris at an altitude of 1650 feet. Owners, W. Newport and F. Whiting, Ethanac California.

A 100-foot shaft was sunk on a small vein in granite. After laying idle for some years it was reported that work was to be resumed in 1918. Apparently this did not materialize. Idle.

Bibl: State Mineralogist's Reports XIII, p. 313; XV, p. 532.

*Oro Copio Mine*. Consists of 2 claims in Sec. 6, T. 2 S., R. 10 E. and Sec. 12, T. 2 S., R. 9 E., S. B. M., 60 miles northeast of Palm Springs and 10 miles from Twenty-nine Palms. Elevation 3600 feet. Owner, Ellsworth Nichols, Santa Ana, California.

The mineralization follows a shear zone in the granite, which here has been altered to gneiss. It is a narrow vein having a N. 10° E. strike.

Development consists of three shafts 50, 100 and 75 feet, respectively. The 75-ft. shaft is said to have been sunk on a 14-inch vein which is reported to carry values of \$8 per ton in gold. Idle.

Bibl: State Mineralogist's Report XV, p. 348.

*The Oxbow Group*. It consists of the Oxbow, Oxbow Nos. 1 to 4 and the Oxbow Fraction, in Sec. 36, T. 1 S., R. 23 E., S. B. M. The claims are in Bendigo District, in the Riverside Mountains. Owners, Messrs. Ware and McMillan, Calzona, California.

Only assessment work has been done.

Bibl: State Mineralogist's Report XV, p. 544.

*O. K.* (McKinley Bill). An old property, now forgotten. It is 5 miles northeast of Mecca.

Bibl: State Mineralogist's Reports XIII, p. 313; XV, p. 538.

*Perris Mine*. It is 5 miles west of Perris at an altitude of 2200 feet. Owner, W. F. Dray, Forestville, Placer County. Idle.

Bibl: State Mineralogist's Reports XIII, p. 313; XV, p. 531.

*Ragged Top Group*. Property is located in the NW $\frac{1}{4}$  Sec. 18, T. 6 S., R. 3 W., S. B. M., in Cottonwood Canyon, 3 miles east of Elsinore. Owner, Peter Swanson, 1117 South Bronson Avenue, Los Angeles.

Developed by 2 tunnels driven on quartz stringers in granite. No. 1 tunnel was driven in a southeasterly direction for 60 feet; No. 2 tunnel, which is 500 feet east of No. 1, was driven 50 feet S. 20° E. This tunnel cut a porphyry dike which strikes northwest and dips 45° E. Idle.

*Red Head Group* (Great Western). This group, which includes the Great Western, White Wing and Red Head is located in the Chucka

valla Mountains. It was a part of the *Red Cloud Mining Company's* property of which S. P. Cressinger was president. Owner, J. M. Huston, Los Angeles. Idle.

Bibl: State Mineralogist's Reports X, pp. 900-901; XV, p. 539.

*San Diego Mine.* It is in the Chuckawalla Mountains, adjoining the Granite Mine on the southeast. Former owner, E. E. Bowles, San Diego, California.

Bibl: State Mineralogist's Reports XII, p. 224; XIII, p. 313; XV, p. 540.

*Santa Fe Mine.* It is one-third of a mile southwest of the Santa Rosa. Owners, R. Woods and Son, Auburndale, California.

Workings of this mine have long been abandoned. Formerly equipped with a 5-stamp mill. Was a producer.

Bibl: State Mineralogist's Reports XII, p. 224; XIII, p. 314; XV, p. 530.

*Santa Rosa Mine* (Mina Rosalia). It is in the NW $\frac{1}{4}$  of Sec. 31, T. 4 S., R. 4 W., S. B. M. Owners, Hook Brothers, Perris, California. It is an old mine now filled with water. A large amount of gold was produced from a 3-foot vein. Worked through opencuts and shafts to a depth of 200 feet. Property was equipped with a 20-stamp mill. Idle.

Bibl: State Mineralogist's Reports XIII, p. 526; XI, P. 385; XII, p. 225; XIII, p. 314; XV, p. 529.

*Schellenger Gold Group.* E. E. Schellenger, of Blythe, has 6 claims 4 miles east of Inca siding on the Santa Fe Railroad. They are in an isolated hill at the west base of the Maria Mountains.

Quartz veins in schist, carrying gold and a little lead, strike east-west and dip steeply to the north. Only assessment work has been done.

*S. S. Mine.* It is 4 miles south of Virginia Dale, in the Monte Negras region, 55 miles northeast of Mecca. Former owner, T. R. Lyon, San Bernardino, California.

Produced some high grade ore but is now forgotten.

Bibl: State Mineralogist's Reports XII, p. 224; XIII, p. 314; XV, p. 538.

*Stanford Mine.* Is 5 miles southwest of Perris. Owner, Mark Herrin, Riverside, California.

A system of overlapping and branching fissures in a massive eruptive rock have been developed by a 125-foot shaft with a crosscut tunnel from the surface intersecting the shaft at 70 feet. Formerly equipped with a 5-stamp mill. Idle.

Bibl: State Mineralogist's Reports XII, p. 225; XIII, p. 314; XV, p. 532.

*Steece Mine.* It includes the Ruby, Washington, Bluebell, Black Warrior and eight other claims, which are largely in Sec. 6, T. 2 S., R. 24 E., S. B. M., about 6 miles southwest of Vidal, in the Riverside Mountains. Owner: It is reported that C. W. Mitchell, Parker House,



Boston, Massachusetts, has taken over this mine, together with the Jackknife and Calzona.

The orebody in this mine is said to occur on a contact between schist on the south or footwall side and limestone on the north.

Development is through a shaft which is reported to be 500 feet deep. Idle, but reported that operations are soon to be resumed (September, 1929.)

Bibl: State Mineralogist's Report XV, p. 543.

*Sterling Mine.* This property consists of a group of claims 30 miles northeast of Salton, in the Hathaway Mountains. Elevation is 2000 feet. Former owner, Sterling Mining Company, Los Angeles.

Considerable surface work was done and a 10-stamp mill erected. Idle.

Bibl: State Mineralogist's Reports, XIII, p. 314; XV, p. 539.

*Sunnyside Mine.* This property was relocated in July, 1929, by Jack Hall of Calexico and Earl Shumway of San Francisco. Idle.

Bibl: State Mineralogist's Reports X, p. 901; XV, p. 539.

*Sunset Group of Claims.* This group comprises 7 claims situated in the Dale Mining District, one mile west of the Gold Crown Mine, and 10 miles west of Twenty-nine Palms. Elevation 2000 feet. Owner, Jack Meek, Twenty-nine Palms, California.

A series of narrow quartz veins occur in the granite. These veins have a general east and west course. They vary in width from 12 inches to 2 feet. Samples taken from different shafts assayed from \$20 to \$50 per ton in gold. A number of shallow shafts have been sunk on the different veins. Idle.

*Thelma Desert Gold Group of Claims.* This group comprises 5 claims situated in the Dale Mining District, about one mile east of the Gold Crown Mine, and 11 miles west of Twenty-nine Palms. Elevation 2100 feet. Owner, Jack Meek, Twenty-nine Palms, California.

On the Thelma Group there is a series of parallel, narrow quartz veins in granite. These veins have a general east and west trend. On Desert Gold Claims, the veins have a general north and south trend. The width of the veins vary from 6 inches to 2 feet. The vein quartz is copper-stained and heavily impregnated with hematite. Sorted ore is said to assay from one to four ounces in gold.

Development consists of a number of shallow shafts sunk on the different veins. One man employed.

*Thurman Claims.* J. G. Thurman of Elsinore has 4 claims in Secs. 19 and 26, T. 6 S., R. 3 W., S. B. M.

A porphyritic dike 4 feet wide, in a granitic schist, having strike N. 20° W. and dipping 70° to the east, is reported to carry \$4 per ton in gold. Only development is a small open cut.

Mr. Thurman also has 2 claims about one mile east of Elsinore, in T. 5 S., R. 4 W. Here a felsite dike in granite and schist carries values which are reported to range from \$7 to \$70 per ton.

Development consists of a 30-foot incline shaft. One man is employed sinking shaft.

*Triangle (Pilot).* It is 3 miles south of Corn Springs in the Chuckawalla Mountains. Elevation about 2050 feet. Owners, Wm. B. Krosse, J. M. Halloway and C. A. McGraw, at Aztec Well, which is about 2 miles south of Corn Springs in Corn Springs Canyon.

A 2-foot vein occurs in the granite with a diorite casing on the hanging wall.

Development consists of three old shafts now caved and inaccessible. The deepest did not exceed 100 feet. New work consists of opencuts and a 15-foot shaft. One ton of sorted ore was hauled to Aztec Well and treated in an arrastra. Reported to have yielded \$125. Assessment work only.

*Victor (La Plomo) Mine.* It is  $4\frac{1}{2}$  miles southwest of Perris.

Bibl: State Mineralogist's Reports VIII, p. 527; XI, p. 384; XII, p. 225; XIII, p. 314.

*Waters Placer.* Mr. Waters, address unknown, is said to own 6 placer claims, 17 miles northeast of Sidewinder Well, which is 45 miles northwest of Blythe.

Produced some gold but no record available. Idle.

*Willow Mine.* It consists of one claim which is 5 miles northwest of Corn Springs, in the Chuckawalla Mountains. Owner, A. Lederer, Corn Springs.

Quartz and calcite vein, with granite and diorite walls. Reported vein is from 6 inches to 4 feet wide. The strike is E.-W. and dip  $30^\circ$  to the south.

Development consists of 30-foot incline shaft and opencuts scattered along the vein for a distance of 750 feet. Idle, except for assessment work.

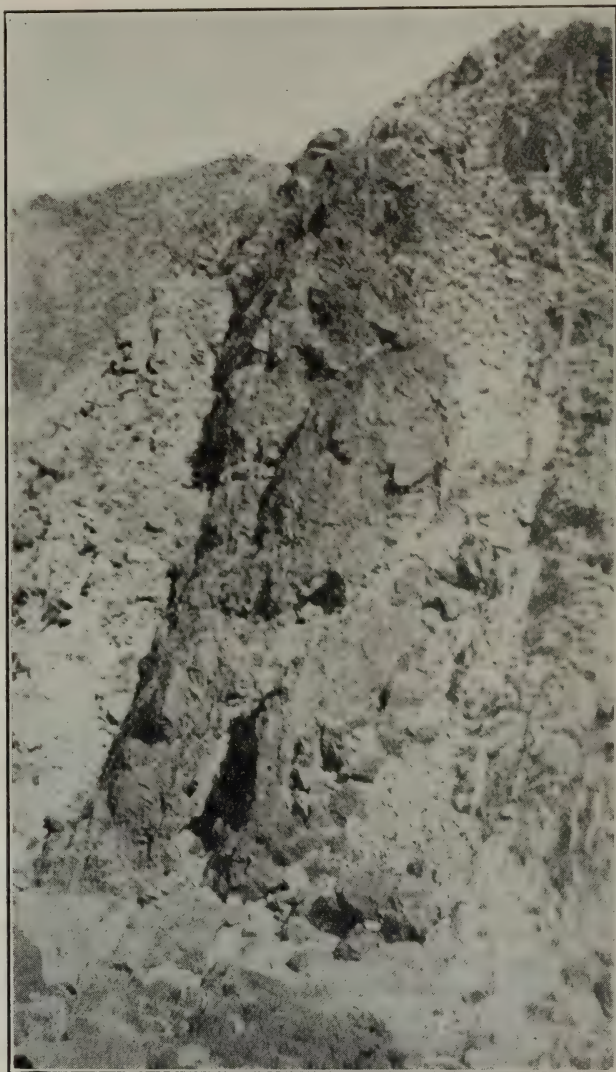
#### IRON.

The most important deposits of iron ore in the southern part of California occur in T. 3 S., R. 14 E., S. B. M., in the Eagle Mountains, in the northern part of Riverside County. The iron ore deposits of this area are large and valuable and when commercial conditions improve, and the proper fuel becomes available, they will form the basis of an important industry for the Pacific Coast.

*Iron Chief Mine.* The Eagle Mountain iron ores are located in the northern part of the Eagle Mountains. They are 40 miles northeast of Mecca, a station on the Southern Pacific Railroad. The deposits extend over an area about 8 miles long and from a quarter of a mile to two miles wide, running across the summit of the Eagle Mountains in a general east-west direction. Holdings comprise 187 patented claims, owned by the Iron Chief Mining Company, which company is controlled by the *Southern Pacific Company*.

The iron ores, with associated metamorphic minerals, occur as replacements in the dolomite which is found in beds and lenses at two principal horizons in the dolomite and quartzite series. The trend of the iron-bearing belt is approximately N.  $70^\circ$  W. The width of outcrops varies from a few feet to 500 feet. The largest body of mixed ore and gangue material exposed is 6000 feet in length and has a maximum width of outcrop of about 500 feet. The ore is predominantly hematite, but here and there consists of magnetite. A consid-

erable percentage is very pure and of high grade, containing between 62% and 67% metallic iron and less than 0.06% phosphorus. E. C. Harder, in Bulletin No. 503, of the U. S. Geological Survey, estimates the tonnage at from 40,000,000 to 70,000,000 tons. The iron ore



Outcrop of iron ore in crystalline dolomite. Iron Chief Mine, Eagle Mountains, Riverside County.

deposits of the Eagle Mountains are fully described in the above-mentioned bulletin.

The only development work noted on the iron deposits consists of a large number of shallow shafts and tunnels on the different claims.



Water from Cottonwood Springs was originally piped into the deposits near the Iron Chief Mine, a distance of 18 miles.

Bibl: State Mineralogist's Reports XV, pp. 544-545; XX, p. 196;  
U. S. Geological Survey Bulletin No. 503.

#### LEAD-SILVER

This metal has been reported in small quantities at several points in the county, the chief occurrence being its association with copper, gold ores of the Black Eagle Mine, which is located in the Eagle Mountains, and is described in detail under 'gold.' At the Black Eagle Mine it occurs as anglesite, cerusite, vanadinite and galena. Ore shipments made from the above-mentioned property carried as high as 23.5% lead. It is also reported to occur in the Chuckawalla Mountains on claims located near the Granite Tanks. Galena occurs in occasional bunches at the Desert Center Mine, which is located about 8 miles south of Desert Center.

*Black Eagle Mine.* (See under Gold.)

*Desert Center Mine.* It consists of one claim which is located in the Chuckawalla Mountains, 16 miles east and about 8 miles south of Desert Center. Owner, S. A. Rapdale, Desert Center, California.

It is reported that a vein, having an average width of 3 feet, is associated with a basic dike in granite. It is traceable for about one-quarter of a mile, has an east-west strike and dips 30° to the south. Galena occurs as occasional bunches in the vein, which also carries a little gold and a few ounces of silver.

Development consists of a 75-foot crosscut tunnel and 20 feet of drift on the vein; also a shaft which is 25 feet deep. Only assessment work is being done.

Mr. Rapdale also has 2 other claims which are 3 miles south of the Desert Center claim. It is reported that the vein is similar to that on the Desert Center claim. It carries spotted values in lead and silver.

Development consists of 125-foot incline shaft and 50 feet of drifts. Only assessment work is being done.

*Neal Group.* It consists of 2 claims in the Maria Mountains, about 19 miles north of Blythe and 3½ miles east of the Santa Fe Railroad branch line from Blythe Junction (Rice) to Ripley. Owner, Neal, Kingman, Arizona.

It is reported that the mineralization accompanies a felsite dike in limestone. Values are in lead-silver and copper. This dike is 50 feet wide, has a northwest-southeast strike and dips to the northeast.

Development consists of a 60-foot shaft and 100 feet of tunnel work. No shipments have been made. Idle.

*Palisades Group.* It consists of 3 claims in Sec. 4, T. 6 S., R. 4 W., S. B. M., 2 miles north of Elsinore. Owner, George Peterson, Elsinore, California.

A series of narrow stringers in schist at and near a granite contact, strike N. 60° E., dip 60° to the east. These are reported to carry spotted values in silver, lead, copper and gold.

Development consists of two opencuts about 10 feet deep. Only assessment work is being done.

## MANGANESE

Ore deposits of this mineral are found at several points in Riverside County. The most important deposits of manganese ore occur in Ironwood District, comprising a small area in the McCoy Mountains, and in the west end of the Maria Mountains, in the eastern part of Riverside County. Commercial deposits of manganese also occur northwest of Palo Verde Valley, close to the boundary line between Riverside and Imperial counties. The principal production has come from the Black Jack, Melville and Social groups of mines. A considerable tonnage of ore was mined and shipped from these districts from 1917 to 1919, inclusive. The production in 1918 was 152,693 tons. In 1919 it amounted to 49,324 tons. The ore produced carried from 35% to 40% metallic manganese, with 0.5% to 2% iron, and from 3% to 8% silica. The ore contained in these deposits consists of the oxides, psilomelane and pyrolusite. Calcite occurs in all the veins, but is more abundant in some of the veins than in others. Deposits of manganese are also found in the vicinity of Elsinore and southwest of Perris. The ore, manganese oxides, occurs as lenses interbedded in jasper.

These deposits are of doubtful commercial value, principally due to high silica content. There has been no commercial production of manganese ore from Riverside County since 1919, principally due to the imports of high grade manganese ores from Brazil, Cuba, Russia and India.

**Mines.**

*Arlington Mine* (formerly known as the Black Jack). This property, consisting now of seven claims, is in the McCoy Mountains, 12 miles west of Inca, a station on the branch line of the Santa Fe Railroad from Blythe Junction (Rice) to Ripley. It is in Secs. 13 and 24, T. 4 S., R. 19 E. Owner, E. E. Schellenger, Blythe, California.

The ore occurs in a series of parallel fractures in a porphyritic rhyolite which is highly brecciated along these lines. Under bond and lease to Robert A. Kinzie and associates of San Francisco. Fifteen hundred tons were shipped in 1915, the average of which was said to be above 40% Mn.

In 1917 and 1918 a bond and lease was taken on it by Charles F. Bradford and associates of Blythe. They shipped about 3000 tons which is reported to have averaged 45% Mn. The ore carries a little barite and has a low silica content.

This property is fully described in Bulletin No. 76. Idle.

Bibl: State Mineralogist's Report XV, p. 545 (under the name of Black Bird); and Bulletin No. 76, pp. 54-56.

*Black Horse Group.* It consists of four claims west of the Black Jack Mine described above. Owners, Floyd Brown, P. H. Bray and W. Simoyne, Blythe, California.

The surface outcroppings show narrow veins in the rhyolite, which are parallel to those of the Black Jack group. Only assessment work has been done.

Bibl: State Mining Bureau Bull. No. 76, p. 56.

*P. H. Bray*, of Blythe, California, has a deposit which lies about 1000 feet south of Claim No. 3 of the Black Jack group.

Some shipments were made during 1918 which are said to have carried 44% Mn. Idle.

Bibl: State Mining Bureau Bull. No. 76, p. 56.

*Brum and Newport Claims.* Geo. Brum, Lloyd Newport and associates are the owners of two groups of manganese claims which are located 7 miles southwest of Ferris, by road. They are on the Temecula branch of the Santa Fe Railroad, one group being to the east and the other to the west of this line. Idle.

They are described as the Brum and Newport Prospect in State Mining Bureau bulletin No. 76, p. 56.

*Doran Manganese Claims.* Two claims which are located in the north end of the Palen Mountains about 10 miles northwest of the Black Jack Mine and 22 miles northwest of Mineral. The road from Mineral to Adams Well lies about 3 miles, in an air line west of the property. From this road it is accessible only by a hard desert trail. Former owner, W. C. Doran et al., Los Angeles.

The manganese occurs in a vein, filling a fault fracture in rhyolite. Idle.

Bibl: State Mining Bureau Bull. No. 76, p. 57.

*Elsinore Manganese Deposits.* These deposits long known and located many years ago, lie 6 miles northeast of Elsinore in Secs. 23 and 24, T. 5 S., R. 4 W. They are on the branch of the Santa Fe Railroad which extends south from San Bernardino. They are divided into two groups. One group of 6 claims is on the west side of the railroad, while the other, consisting of 9 claims, is on the east side and about one-half mile farther north than the first group. Owner, Charles P. Carter, Elsinore, California.

There are two parallel veins in granite and schist. The principal one outcrops some 1500 to 2000 feet distant from and 400 to 500 feet above the railroad in Sec. 23.

Nothing but assessment work has been done.

Bibl: State Mineralogist's Report XV, p. 546; Bull. 76, p. 58.

*Grosse Manganese Claims* (formerly Melville No. 2). This group consisting of five claims is about one-quarter of a mile south of the Black Jack Group, in the McCoy Mountains. Owner, C. E. Grosse, Blythe, California. Some shipments were made during 1918. Idle.

Bibl: State Mining Bureau Bull. No. 76, p. 58.

*Hauser, Martin and Cheeseborough Claims.* Mr. Hauser, 1138 Oxford Avenue, Los Angeles, owner. This group consisting of seven claims is on the east slope of the Maria Mountains,  $2\frac{1}{2}$  miles west of Inca Siding on the Santa Fe branch from Blythe Junction (Rice) to Ripley. It is just south of the Mabery and Brown (Langdon) deposit described below.

Three cars of ore were shipped from this property in 1916 by the Noble Electric Steel Company, of San Francisco, and very little ore is now exposed. Idle.

Bibl: State Mining Bureau Bull. No. 76, p. 58.



*Mabery and Brown Deposit* (formerly known as Dioxide Manganese Group). It consists of twelve claims which lie at the base of the east slope of the Maria Mountains,  $2\frac{1}{2}$  miles west of Cox Siding, which is 2 miles south of Mineral. Owner, C. M. Langdon, Los Angeles.

The manganese ore here occurs in fractures in a hard, grayish-white or pink limestone and as replacement lenses along the bedding planes of this rock. There are numerous outcrops on the surface. The fractures in the limestone have a strike of about N.  $15^{\circ}$  W. and dip at approximately  $30^{\circ}$  to the west. The lenses conform to the dip of the limestone which, on this property, is to the east.

The main workings are in a canyon on the southern portion of the property. At the bottom of an 8-foot shaft, a large chamber was excavated in the hillside. Here the ore was 8 feet wide and this lens yielded several cars. Other development in this canyon consists of two shafts 40 feet and 60 feet deep, respectively. The 60-foot shaft was sunk on a 3-foot vein of high grade ore.

In the next canyon to the north several opencuts, short tunnels and a 25-foot shaft have been excavated. It appears that there are three principal, parallel zones of mineralization here. One tunnel S.  $15^{\circ}$  E., 50 feet long shows approximately 10 feet of ore in the face. This ore appears to have a horse of limestone in it, but it is given that appearance by reason of the fact that here is the junction of a fracture, dipping west, with one of the bedding-plane lenses dipping east. Approximately 75 tons of ore is now piled on the various dumps and it all appears to be of excellent grade. It is believed that a considerable tonnage of a good grade of ore can be quickly developed on this property. Mabery and Brown are reported to have shipped 30 cars and C. M. Langdon 8 cars from these deposits. The average grade of these shipments is said to have been above 40% Mn. and about 2% silica. Idle.

Bibl: State Mining Bureau Bull. No. 76, p. 59.

*Palo Verde Region Manganese Claims.* Messrs. Lugo and Justice Smith, of Palo Verde, Imperial County, California, are reported to have made shipments of ore carrying 35% metallic manganese from a group of claims which lie close to the line between Riverside and Imperial counties. These claims are 8 miles northwest of Palo Verde and 10 miles west of the Colorado River. Idle.

Bibl: State Mining Bureau Bull. No. 76, p. 59.

*Palen Mountains Deposit.* Frank Coffey, Mecca, California, has a number of manganese claims in the Palen Mountains northwest of Blythe.

*Schellenger Manganese Claims.* E. E. Schellenger, Blythe, California, has two groups of manganese claims in the Ironwood Mining District, in the McCoy Mountains. They are 11 miles west and 6 miles south of Mineral.

It is reported that the veins are along fractures in quartz porphyry. Strike N.  $10^{\circ}$  W., and dip steeply to the west. Average width of about 18 inches.

One car of ore was shipped from a 2-foot vein which, it is said, ran 31% Mn., carried some barite and was high in iron. Idle.

Bibl: State Mineralogist's Report XV, p. 546.

#### TIN

The Temescal tin deposit was discovered about 1853 and in 1860 a company was formed to work the mine. The outbreak of the Civil War in 1861, caused operations to be suspended and nothing further was done until about 1868.

The San Jacinto Tin Mining Company was organized January 2, 1868. The company acquired the Rancho Sobrante de San Jacinto, a Spanish grant, comprising 49,000 acres of land. In 1868 work was resumed on the Cajalco Mine. The deposit was acquired and worked by an English syndicate from 1880 and 1892. During this period 10,000 tons of ore was extracted from the Cajalco Mine that is said to have averaged 4% tin oxide.

The production in 1891 was 125,289 pounds of tin, valued at \$27,564. In 1892 the production was 126,000 pounds valued at \$32,400; the total production being 251,289 pounds, valued at \$59,964.

#### Geological Features.

The area where the tin ore occurs is located 5 miles south of Arlington on the western portion of the Rancho El Sobrante de San Jacinto. The occurrence of tin ore is found in the tourmaline veins at Cajalco Hill and to a point south about 2 miles. There is a semicircular area of granite over 2 miles in diameter, surrounded on the northwest and south by porphyry and adjoining on the east a great body of granitic rocks. Cutting through the granite in a northeast and southwest direction are black tourmaline veins which form the gangue of the tin ore, when it is present. There are two varieties of tin ore: The yellow, occurring in thin layers in a non-crystalline form, and the brown, in granular form in the massive specimens, or in small, clear, reddish-brown crystals lining cavities. The occurrence of tin is also found in tourmaline veins that occur in the granite in the vicinity of Elsinore and Perris. The *American Tin Corporation* acquired the Temescal Tin Mine and other properties on the Rancho el Sobrante de San Jacinto in the early part of 1927 and has spent a large amount of money in the exploration of the different tourmaline veins on the property.

The work has been well-planned and it is hoped that the company's efforts will be rewarded by development of orebodies of commercial grade.

#### Mines.

*Black Rock Tin Deposit.* It comprises 400 acres, located in Secs. 18 and 19, T. 4 S., R. 5 W., S. B. M., 2 miles southeast of Cajalco Hill, on the Rancho El Sobrante de San Jacinto and 7 miles south of Arlington. Elevation 1400 feet. Owner, Black Rock Tin Syndicate; P. H. Gorman, president; G. H. Bryant, vice president and general manager; H. C. Field, superintendent.



Twelve parallel tourmaline veins occur in the granite on this property. The general course of these veins is northeast and southwest and they dip  $60^{\circ}$  to the southeast. The widths of the veins vary from 4 to 30 feet. It is stated that samples taken from along the outcrop of these veins carried traces of tin. Some of the vein outcrops are stained with copper oxide.

Development consists of incline shaft sunk to a depth of 125 feet and it is planned to sink this shaft to a depth of 200 feet before drifting on the vein. It is also stated that at a depth of 200 feet, the other parallel veins will be developed by a crosscut.

Equipment consists of 6- by 8-in. Chicago pneumatic compressor and a Sullivan tugger hoist. Four men are employed.

*Chief of the Hills Tin Group.* This property which is owned by J. M. Mack, Clay L. Berry and Mary Briner, all of Elsinore, California, is located in Sec. 4, T. 6 S., R. 4 W., S. B. M., on the top of a mountain, 2 miles northeast of Elsinore. Elevation 1900 feet. It comprises five claims located in December, 1926.

A belt of slate, schist and felsites having an approximate width of 2000 feet, forms a lens, 4000 feet long in the granite. The rocks in this belt strike N.  $30^{\circ}$  W., and dip at an angle of  $80^{\circ}$  to the east. In this series there are five principal vein dikes, having the same strike and dip as the enclosing rocks. These dikes which consist of fine-grained granite have been replaced in part by minutely crystalline tourmaline and quartz. At these points tin has been reported as occurring in amounts varying from 0.30% to 2.21%. The only form observed was the reddish-brown crystals, lining cavities in the tourmaline. On one of these vein dikes, a shaft has been sunk to a depth of one hundred feet. At the bottom, it is reported that a crosscut has been driven 20 feet to the east and 10 feet to the west of the shaft. The west crosscut, according to reports, was driven in material which assayed from 0.31% to 1.22% tin. Idle.

*Holmes Ranch Tin Deposit.* It comprises 560 acres located in Sec. 12, T. 4 S., R. 6 W., S. B. M.,  $1\frac{1}{2}$  miles southeast of Cajaleo Hill and 5 miles south of Arlington. Elevation 1300 feet. Owner, Lawrence Holmes, Arlington, California. Under option to *Southern California Tin Corporation*, of New York; Charles Miller, president.

On the northwest portion of Sec. 12, there is a tourmaline vein in the granite, which strikes northeast and southwest. The vein outcrop is from 6 to 15 feet in width and can be followed on the surface for a considerable distance. It is reported that samples taken at intervals along the outcrop of the vein showed traces of tin, with some assays carrying 0.30%. No development has been done on the vein. Idle.

*Moore Tin Deposit.* It comprises 600 acres located in Secs. 13, 14, 23, 24, T. 4 S., R. 6 W., S. B. M., about 2 miles southeast of Cajaleo Hill, and 7 miles south of Arlington. Owner, Robert L. Moore Estate, Riverside, California.

A series of parallel veins of tourmaline cut the granite and strike northeast and southwest.

Development consists of several shallow shafts 20 to 40 feet deep on the different veins. On the west end of the property in Sec. 13 on the contact of porphyry and granite, copper oxides occur. The granite



s mineralized with chalcopyrite. Samples taken along the outcrop carry 2% to 5% copper. Two men employed.

*South Black Rock Tin Deposit.* Comprises 80 acres located in Sec. 9, T. 4 S., R. 5 W., S. B. M., about 3 miles southeast of Cajalco Hill, and 7 miles south of Arlington. Elevation 1500 feet. Under option to the *American Tin Corporation*; P. H. Gorman, president; G. H. Bryant, vice president and general manager. Offices, 21 East Fortieth Street, New York City.

Eight parallel veins of tourmaline occur in the granite. These veins have a general course of N. 30° E., and dip 60° to the southeast. The widths of the veins vary from 6 to 10 feet. Samples taken along outcrops are stated to carry from 0.13% to 0.5% tin oxide.

Development consists of several shallow shafts sunk on the vein outcrops, the deepest being 25 feet. Idle.



No. 1 Shaft, Temescal Tin Mine, American Tin Corporation, Riverside County.

*Temescal Tin Mine.* The Temescal tin mine is located in the western part of Rancho el Sobrante de San Jacinto, about 5 miles southeast of Corona. Holdings comprise 870 acres located in Secs. 2, 3, 10, 11, T. 4 S., R. 6 W., S. B. M. Owner, *American Tin Corporation*; P. H. Gorman, president; A. J. Veinus, secretary; G. H. Bryant, vice president and general manager; H. C. Field, general superintendent. Local office, 594 Main street, Riverside, California.

This company acquired the property in March, 1927, and it has been under extensive development since that date. The country rock is a coarse hornblende-biotite granite. Tin occurs as cassiterite in black tourmaline veins in the coarser grained granite. There are 65 parallel veins in the granite, 10 of which have been explored. The veins vary from one inch to 15 feet. The general course of the veins is northeast and southwest and they dip from 55° to 75° to the northwest. The

vein matter does not wholly consist of tourmaline but contains quartz grains scattered through it in the same proportions as in the granite.

The tin is not found to any extent in the quartzose gangue. Sample taken from the surface outcrops of the different veins show an average of 0.03% metallic tin. Some samples carried as high as 2% tin. Ter of these parallel veins have been more or less developed by tunnel shafts and have been stripped for a considerable distance along their outcrops.

The main development work is confined to No. 1 vein, which is located on Cajaleo Hill. This vein was explored by the former operators by two shafts sunk to a depth of 180 feet. The main orebody lay in the center of the workings and extended downward in the dip of the vein. The ore extracted from this orebody averaged 4% tin oxide. This orebody, known as the Cajaleo, extended down to the 300-foot level, and had a maximum width of 15 feet, with an average width of 6 feet. The orebody was 300 feet in length.

No. 1 shaft has been sunk to a depth of 650 feet on an incline of 65°. The shaft encountered the above-mentioned orebody at 100 feet from the surface. Seven levels have been driven on the vein, about 65 feet apart.

No. 1 level, adit tunnel level is 270 feet in length. At No. 2 level there is a drift 360 feet southwest of shaft and 200 feet northeast. No. 3 level drift 560 feet southwest and 200 feet northeast; No. 5 level drift 500 feet; No. 6 level drift 500 feet.

The present development is confined to driving a crosscut south from No. 7 level to cut the different parallel veins. The development work so far prosecuted below the 300-foot level has been disappointing in that it has failed to find the downward extension of the orebody that was worked between the 300-foot level and the surface. Also no commercial ore has been developed by the different drifts and crosscuts below No. 3 level. The No. 2 vein which is located about 600 feet south of No. 1 vein, has been prospected by a shaft 75 feet deep. No. 4 and No. 5 veins are being developed by a shaft sunk to a depth of 180 feet. At a depth of 100 feet, some ore was encountered carrying values in copper and silver. The vein material is mineralized with chalcopyrite, pyrite and is said to carry 2% copper, with one ounce of silver. No. 4 vein is also developed by a shaft sunk to a depth of 175 feet. On the 170-foot level a drift has been driven southwest 300 feet. No. 9 vein which is located one mile southeast of No. 1 shaft, is being developed by a tunnel driven southwest on the vein 500 feet. The vein has an average width of 4 feet. Samples taken at intervals from the vein show a trace up to  $1\frac{1}{2}$ % tin oxide. The other veins have been prospected by shafts sunk to depths of 75 to 100 feet.

Mine equipment: The equipment at No. 1 shaft consists of a double drum hoist driven by 100-h.p. motor; (17- by 10-in.) (10- by 14-in.) Ingersoll-Rand compressor; two Gould triplex pumps, each having a capacity of 120 gallons per minute; one Gould triplex pump with a capacity of 200 gallons per minute; blacksmith shop equipped with Ingersoll-Rand drill sharpener and oil-fired furnace; three portable 6- by 8-in. Chicago pneumatic compressors; three Sullivan tugger hoists.



Mill: This is a testing plant having a capacity of 10 tons. The equipment consists of rock crusher, small Hardinge mill, vibrating screen, 2 Wilfley concentrators.

A number of mill tests have been made on ore from No. 1 vein. The ore treated averaged 5% tin oxide and the concentrates produced ran from 30% to 60% metallic tin. Electric power is secured from the Southern Sierras Power Company. Twenty-five men are employed.

### NONMETALLIC MINERALS

The rapid growth of the cities on the Pacific Coast, especially the city of Los Angeles which in recent years has become the industrial center of Southern California, has caused an increasing demand for both industrial and structural materials.

Riverside County has a great variety of commercial minerals which are used locally and a large tonnage of both industrial and structural materials are shipped into the city of Los Angeles. Commercial deposits of granite and limestone are distributed throughout this county. The Alberhill-Corona District in western Riverside County is one of the three most important clay producing areas in the state. Commercial deposits of feldspar and silica occur at various points throughout the county. Riverside County and San Diego County are the largest producers of feldspar and silica in the state. There are extensive deposits of gypsum of commercial grade in the eastern part of the county. The more important of these minerals thus far exploited, shown by the output, are clay, feldspar, granite, gypsum, limestone, mineral water, onyx and silica.

### ASBESTOS

*Percival Asbestos Deposit.* It comprises 4 claims located in T. 6 S., R. 5 E., S. B. M., 15 miles south of Palm Springs and 8 miles east of Indio. Owner, J. O. Percival, Idylwild, California.

Asbestos of the amphibole variety occurs in veins as slip-fiber traversing a granular olivine-hornblende rock. The largest vein of asbestos exposed in the workings was two feet thick.

Development consists of tunnels and opencuts. Only assessment work is being done on the property.

Bibl: State Mineralogist's Report XV, pp. 550-553.

*Perris Asbestos Deposit.* It comprises 35 acres located 2 miles southwest of Perris, about one-quarter of a mile east of highway, between Perris and Elsinore. Owner, J. O. Walser, Los Angeles.

Amphibole asbestos occurs in a shear zone in the granite. A number of shallow opencuts have been made on the vein, which is from 6 inches to 2 feet in width. It is reported that 15 tons of material was extracted from the different opencuts and shipped to Los Angeles. Idle.

### CEMENT

(See under Limestone.)

### CLAY

The Alberhill-Corona District in western Riverside County is one of the three most important producing areas in the state. The clay



deposits extend in a belt along the Temescal Valley for 15 miles from Elsinore on the southeast to Corona on the northwest. The clays were laid down in Eocene time, when the Temescal Valley was an arm of the sea opening northward into the valley of western San Bernardino County and extending southerly to Temecula. The width of the basin is from one to two miles and its depth in places is over 600 feet. Outside of Alberhill-Corona District, few commercial clay deposits have thus far been found in the county. Common clays are sufficiently abundant in the county to serve all requirements for the manufacture of common brick. The desert portions of the county have not been thoroughly prospected for clays and there is a possibility that in the future some interesting deposits will be discovered. In this report no attempt is made to describe the individual deposits of clay, as they have been taken up in detail in 'Bulletin No. 99, 'The Clay Resources and Ceramic Industry of California,' by Waldemar F. Dietrich. Only those deposits that have not been described in the above-mentioned bulletin are given in detail here.

*Alberhill Coal and Clay Company, Inc.*, offices 1031 South Broadway, Los Angeles; Chas. Biddle, general manager. The company owns 2000 acres of land, located in Secs. 15, 22, 23, T. 5 S., R. 5 W., S. B. M. in Temescal Canyon, near Alberhill.

Bibl: State Mineralogist's Reports XV, pp. 559-574; XIX, pp. 185-210; Bulletin No. 38, pp. 221-222; Bulletin No. 99, pp. 163-169.

*Emsco Clay Company* (Harrington Deposit). The Emsco Clay Company, of Los Angeles, has leased from John Harrington, the Harrington Clay Pit, in Sec. 25, T. 4 S., R. 6 W., S. B. M., in Temescal Canyon, 10 miles southeast of Corona. Holdings comprise 80 acres.

Bibl: State Mineralogist's Report XV, p. 568; Bulletin No. 38, p. 223; Bulletin No. 99, p. 171.

*Gladding, McBean and Company's Clay Deposit*. The clay property is located at Alberhill, in Secs. 21 and 22, T. 5 S., R. 5 W., S. B. M. adjoining the Alberhill Coal and Clay Company's property on the east. Holdings comprise 530 acres.

Bibl: Bulletin No. 38, p. 223; Bulletin No. 99, pp. 171-174.

*Hancock Clay Deposit*. C. P. Hancock and Son, 1330 Lemon Street, Riverside, California, have a red clay deposit which is located on the southern outskirts of the city of Riverside. It is used by them for the manufacture of common red brick.

Bibl: Bulletin No. 99, p. 181.

*Hoff Ganister Fire Brick Company*. J. D. Hoff, president. The company owns 100 acres located in Sec. 22, T. 5 S., R. 5 W., S. B. M. near Alberhill, in Temescal Canyon.

Bibl: Bulletin No. 99, p. 474.

*Jones Clay Deposit*. It is in Secs. 17 and 19, T. 4 S., R. 6 W., S. B. M., on the old Hoag Ranch, 7 miles southeast of Corona. Owned by A. E. Jones, Corona, California.

The outcrops of several clay beds are exposed in an east-west canyon on this property. These vary from a very light-weight dry, blocky clay, near the mouth of the canyon to beds of dark-gray, plastic clay in the main mountain at the head of the canyon,  $1\frac{1}{2}$  miles west. The general dip of these strata is to the southwest, at an estimated angle of  $20^\circ$ . The clay near the mouth of the canyon forms low hillocks on the southeast side, while those in the head of the canyon occur in beds of from 6 to 8 feet in thickness, interbedded with sand and sandy clays. Development consists of several short tunnels. The principal work has been done in the main mountain at the head of the canyon and consists of 4 tunnels varying from 70 to 180 feet in length. These were driven on two coal seams which occur on the top and bottom, respectively, of a gray, plastic clay bed which has an approximate thickness of 6 to 8 feet and dips to the southwest at about  $20^\circ$ . The coal seam at the outcrop is from 4 to 10 inches thick. Old workings in the coal seam are reported to have shown 4 feet thickness at 90 feet from the surface. It is possible that the clay beds here would have been removed by underground mining methods, since they dip into the mountain, and therefore may have excessive overburden for open pit mining. Idle.

*Kroonen Clay Deposit.* It is situated in Secs. 4, 9 and 10, T. 4 S., R. 7 W., S. B. M., 4 miles south of Corona. Holdings comprise 90 acres. Owner, Leo Kroonen, Corona, California.

On the property there are deposits of plastic, vitrifying and fire clays.

Development consists of tunnels and opencuts. Idle.

*Los Angeles Brick Company* The property at Alberhill consists of the SE $\frac{1}{4}$  and the E $\frac{1}{2}$  of the SW $\frac{1}{4}$ , Sec. 21, T. 5 S., R. 5 W., S. B. M., and other property totaling 720 acres. Main office of company, 1078 Mission Road, Los Angeles.

Bibl: Bulletin 38, p. 223; Bulletin No. 99, pp. 174-176.

*Morton Clay Deposit.* It comprises 80 acres located  $2\frac{1}{2}$  miles northwest of Elsinore. Owner, George H. Morton and Son, Elsinore, California.

Development consists of two opencuts, about 200 feet in length and 100 feet wide and 20 feet deep.

The soil and red clay overburden is 15 to 25 feet thick, which overlies beds of blue plastic clay. The beds of blue clay have a general strike of north and south and dip about  $15^\circ$  to the west. These beds vary from 15 to 25 feet in thickness. The overburden is first stripped off with a steam shovel and the clay from pits is loaded into trucks by a steam shovel. The clay is hauled in trucks and unloaded on the ground at the property for storage. Six men employed.

*Pacific Clay Products Company*, Robert Linton, general manager, 51 South Broadway, Los Angeles. This company has several clay properties in the area between Corona and Elsinore.

The Douglas Pit is an 80-acre tract, consisting of the N $\frac{1}{2}$  of the NE $\frac{1}{4}$ , Sec. 22, T. 5 S., R. 5 W., S. B. M.

The Hoist Pit is a 40-acre tract, being the NE $\frac{1}{4}$  of the NE $\frac{1}{4}$  of Sec. 23, T. 5 S., R. 5 W., S. B. M.

McKnight Pit is in Secs. 3, 9 and 10, T. 4 S., R. 7 W., S. B. M. has been worked for over 30 years.

Wildomar Kaolin Deposit consists of 18 acres in R. 3 W., T. 7 S. S. B. M.

They also own miscellaneous parcels in the Alberhill District having a total acreage of 428.79, together with a one-half interest with Gladding, McBean and Company in 120 acres, comprising the  $W\frac{1}{2}$  of NE and the  $SE\frac{1}{4}$  of the  $NE\frac{1}{4}$  of Sec. 26, T. 5 S., R. 5 W., S. B. M.

Bibl: State Mining Bureau Bulletin No. 38, pp. 223, 224; Bulletin No. 99, pp. 176-181.

*Temescal Water Company* (?). Small pit in Sec. 35, T. 4 S., R. 7 W., S. B. M.

Bibl: Bulletin No. 99, p. 181.

*J. W. Wilson*, of Vidal, California, has 26 claims located on an extensive clay deposit which is 3 miles south of Vidal. This deposit is in Riverside County.

Bibl: (Riverside County Clay Deposits) State Mining Bureau Bulletin No. 38, pp. 221-224 and 252-253; Bull. No. 99, pp. 181-182; Prel. Rept. 7, pp. 74-91; State Mineralogist's Reports X pp. 559-574; XIX, pp. 185-219; also *Journal Amer. Ceramic Society*.

#### FELDSPAR AND SILICA

*American Encaustic Tiling Company*, 2030 East 52d St., Los Angeles is working deposits of feldspar and silica which are located on an 80 acre tract, under lease from the *California Land and Mineral Company*. This property comprises Sec. 4, T. 7 S., R. 3 W., S. B. M. and the northwest corner of the Temecula Rancho, being about 3 miles from the town of Murrietta.

The deposits occur in roughly parallel zones in the granite. The strike of these zones is  $S. 75^{\circ} W.$  and the dip is about  $40^{\circ}$  to the southeast. The feldspar, which is orthoclase, occurs in masses in the quartz and is also segregated on each wall between the granite and silica sheets, having a thickness which varies from one to six feet. The total thickness of feldspar and quartz at one point is 80 feet as shown in an open cut from which most of the shipments have been made. Here a pit 60 feet deep, 40 feet wide and 120 feet long has been excavated. From the bottom of this pit crosscuts were driven north a distance of 40 feet to the north wall of the deposit. Raises were put up to the top capping and the feldspar and quartz were removed by top slicing without caving the surface. These slices were eight feet thick. The stoping was carried beyond the east end of the open pit so that the developed length of this lens is 250 feet. It is estimated that there is now blocked out at this point between 30,000 and 50,000 tons.

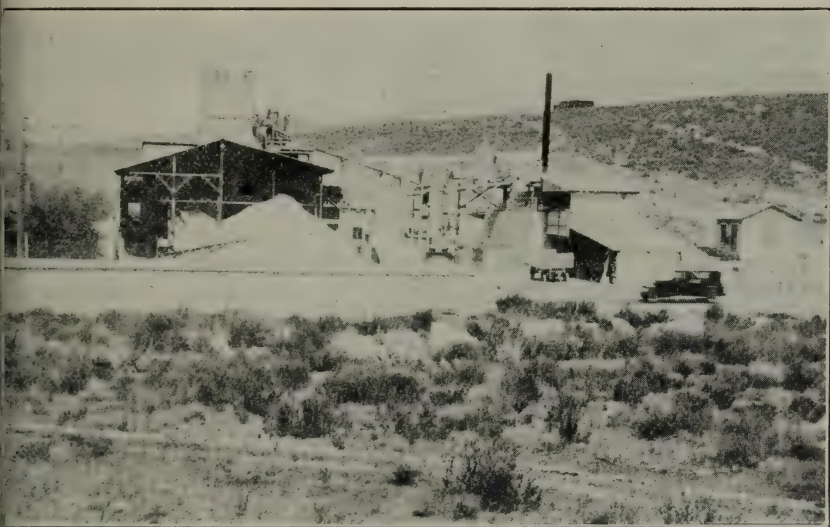
Material is hoisted from the pit in  $\frac{3}{4}$ -ton cars by a 15-h.p. gas engine hoist. It is dumped into a  $3\frac{1}{2}$ -foot trommel, set on a very slight inclination. This machine is used as a washer, a stream of water being passed through with the rock. The two products from the trommel



is conveyed by a short belt to a two-compartment, 40-ton bin, which discharges into trucks below.

On the north side of a small hill about one-half mile west of the above-described pit, a crosscut is being driven. This crosscut passed through 40 feet of granite into a lens of feldspar and quartz which it has penetrated for a distance of 30 feet, the face showing the same material. The top 3 feet of this deposit is feldspar. Numerous small boulders are scattered over the property. One of these is reported to have produced 2000 tons of feldspar from a small lens which was mixed with quartz. At present they are shipping 200 tons per month. Total shipments to date are approximately 30,000 tons. Three men are employed.

This company also formerly operated a deposit which has been variously called the *S. P. Mine* and the *Nuevo*. It is in Sec. 31, T. S., R. 2 W., 4 miles south of Lakeview on the Santa Fe Railroad.



Corona Silica Sand Plant, Corona, Riverside County.

was worked during 1916, 1917 and 1918 by the *West Coast Tile Company*. American Encaustic Tiling Company bought the land from the Southern Pacific Railroad.

A considerable tonnage of silica and feldspar was taken out of an open pit which is 150 feet wide by 45 feet high.

The deposit is a segregation in granite, having a northwest strike and dipping  $60^{\circ}$  SE. While generally the silica and feldspar were intimately mixed, they also occurred in layers which could be mined separately. It was a fine quality of feldspar, carrying 11% potash. The silica was clear and white, showing no impurities. Idle and presumably exhausted.

*Coahuila Brave Feldspar Deposit.* C. E. Williamson, 1107 West 56 Street, Los Angeles, is working deposits of feldspar and silica, on 5 claims in the Coahuila Mountains, 35 miles east of Temecula. These

claims are known as Coahuila Brave, Nos. 1, 2, 3, 4 and 5. The present workings are near the top of Coahuila Peak at an approximate elevation of 5500 feet.

It is reported that there are seven roughly parallel segregation zones in granite, having an average width of 10 feet. These zones have northeasterly strikes and dip at an angle of approximately  $60^{\circ}$  to the southeast. The feldspar occurs in masses which are enclosed by the clear, vitreous quartz.

Present operations are carried on in an open-cut which is 40 feet deep, 10 feet wide and 75 feet long, near the top of the mountain. The sorted feldspar is taken down the mountain by a low-gear truck and put into a 4-ton bin from which a higher geared truck receives it for transportation to the railroad at Temecula.

On account of its isolation and the fact that the property was idle at the time, this deposit was not visited. The above information was given by Mr. Williamson.

*Corona Sand Deposit.* It is 6 miles southeast of Corona, and comprises 800 acres, 100 acres of which has a proved thickness 110 feet of sand. Owner, P. J. Weisel, Corona, California.

Capacity of washing and screening plant is 50 tons. Material from sand pit is delivered to the plant by dragline scrapers. Products produced, glass sand, steel foundry sand and sand blast sand. Ten men employed.

*Ensley-Spaulding Deposit.* Oliver P. Ensley and H. H. Spaulding of Hemet, California, are reported to have shipped 4 cars from deposit of feldspar and silica which is located 7 miles southwest of Hemet and 4 miles from Egan.

It consisted of several small lenses in granite, the feldspar having a thickness of one foot. This pinched out at a depth of 20 feet.

*Hemet Silica Mine.* The *San Jacinto Rock Products Company*, George Green, president, San Jacinto, California, is working a quartz deposit which is located in Sec. 27, T. 5 S., R. 1 W., S. B. M., 3 miles south of Hemet on the Polly Butte. This property, which was formerly worked by the Hemet Silica Company, is at an elevation of 1850 feet.

The deposit consists of a series of lenses of quartz in granite, having a maximum width of about 75 feet. Strike north and south and dip  $80^{\circ}$  to the east.

The principal development is on the northwest slope near the top of the hill. It consists of an open-cut 25 feet deep by 50 feet long, exposing about 75 feet of solid quartz. On account of the iron content it is classed as second-grade silica. The product from this deposit is hauled by truck to San Jacinto where the company has a grinding plant equipped as follows:

Jaw crusher, 11 by 15-in, fed by hand, elevated to 18 by 36-in rolls, elevated to 3-deck vibrating screen; oversize from screen to bin compartment from which it is later fed back to the rolls. The rolls are set up for finer crushing while this is being done. Screen product goes to a 6-compartment bin having a capacity of 50 tons. From bin it may be loaded into trucks or railroad cars. The entire plant is run by a 40-h.p. motor.



This plant is also used to crush limestone from a deposit in Battiste Canyon, owned and operated by the company, also to crush granite which is hauled from Coyote Pass. Only one man employed at the time it was visited.

#### GLASS SAND

*Jones Deposit.* It is on the old Hoag Ranch, 7 miles southeast of Corona, in Secs. 17 and 19, T. 4 S., R. 6 W. The American Fruit Growers branch of the Santa Fe Railway is three-quarters of a mile northwest of the deposit. Owner, A. E. Jones, Corona, California. The deposit forms a chain of four low hills, the axis of these hills has a general east-west direction, and they rise approximately 150 feet above the bottom of the canyon. The tops are only a few feet across, while at the base the thickness is about 250 feet. The total length is 200 to 1500 feet. These hills appear to be entirely composed of unconsolidated sand, consisting of rounded grains of silica, with very little or no visible impurities. The overburden consists of  $1\frac{1}{2}$  to a maximum of 4 feet of sandy soil. The deposit dips to the southeast at an angle which is estimated to be about  $20^\circ$ . It is reported that the raw material carries 97.45% silica and 97.54% after it is washed and screened, also that the iron content varies from 0.09% to 0.11%, with very little mica. It is said that this material is suitable for the manufacture of glass. Idle.

*La Borde Deposit.* It is in Sec. 28, T. 4 S., R. 2 W., S. B. M., 4 miles southeast of Nuevo, on the slope of the Lakeview Mountains. Owners, La Borde Brothers, Perris, California. The feldspar occurs in pegmatite dikes in the granite. About 2000 tons were shipped to the C. W. Hill Chemical Company, of Los Angeles. Idle.

*Lang Deposit.* It is located 4 miles east of Aguanga and 27 miles east of Temecula in the NE.  $\frac{1}{4}$  of the SE.  $\frac{1}{4}$  of Sec. 12, T. 8 S., R. 1 E., S. B. M.; also fraction of NW.  $\frac{1}{4}$  of SW.  $\frac{1}{4}$  of Sec. 7, T. 8 S., R. 2 E. comprises 84.7 acres. Elevation 3600 feet. Owner, J. S. Lang, Aguanga, California.

Silica and feldspar, occurring in granite, outcrop for a distance of 200 feet. Strike is N.  $20^\circ$  W., dip  $60^\circ$  W. Exposures on three small hills. Width as exposed about 20 feet. The feldspar is orthoclase and carries 10% to 11%  $K_2O$ . The silica is also of good grade.

Development consists of an opencut which is 20 feet wide, about 50 feet in length and 10 feet deep on the most northerly hill. On the west side of the cut there is exposed 3 feet of quartz, then 5 feet of feldspar, followed by 10 feet of mixed quartz and feldspar. Continuity and size of outcrop would indicate that a considerable tonnage could be developed here. Idle.

*Machado Deposit,* M. Machado, Temecula, California, has feldspar and silica deposits which are located in Sec. 9, T. 5 S., R. 2 W., S. B. M., 10 miles north of Winchester. The tract consists of 480 acres, 160 acres in eight mining claims and 320 acres under lease from W. J. Bierdorf, of Winchester, California. This property is in Rattlesnake Canyon and the deposits have been opened in the hills on each side of the canyon.



They are segregations in granite, having a strike of N. 40° E. and dipping at low angles to the northwest. Width varies up to 30 feet. Feldspar occurs in masses enclosed by the quartz.

There are numerous opencuts and trenches on the property from which it is reported that 60 cars have been shipped to the American Encaustic Tiling Company in Los Angeles.

*Perris Mining Company*, Route 1, Box 33, Romoland, California has been operating a feldspar and silica deposit which is in Sec. 16 T. 6 S., R. 3 W., 10 miles south of Perris. It is at an elevation of 1400 feet.

The deposit is a segregation in granite, having a strike of S. 70° W. and dipping 42° to the southeast at the surface. The feldspar occurs in masses in the quartz. It is reported that some of these masses have a thickness of 20 feet.

Development consists of an incline shaft which bears S. 15° E., has an inclination of 42° and a length along the incline which is reported to be 150 feet. Fifty feet east of this incline is a vertical shaft with a reported depth of 80 feet. The two are connected on the fifty-foot level and the ground has been stoped from this level practically to the surface. On the 75-foot level in the inclined shaft, a drift has been driven to the northwest a distance of 50 feet. In the end of an open cut, 50 feet east of the vertical shaft, is the portal of a tunnel approximately 15 feet below the surface. It is reported that this tunnel was driven in an easterly direction for a distance of 500 feet. No deposits of commercial value were encountered in the tunnel. As all of these workings were full of water at the time of visit, they could not be inspected.

At the incline shaft there is a small air hoist which raises a  $\frac{1}{2}$ -ton skip. From a 10-ton bin the material goes through a trommel into a car which is trammed to the mill. At the vertical shaft there is a 6-h.p. gas engine. The skip dumps into a 20-ton bin. A trestle connects this with the top of the bin at the inclined shaft. At the mill, a 6 by 9-in. jaw crusher is fed by hand, thence to 12-in. rolls, elevated to a 3-deck vibrating screen discharging to a 4-compartment bin. The material is then further ground by means of a pebble mill. Two dust collectors and two air separators complete the equipment. A 25-h.p. gas engine is so placed that it may be used to drive either an 8 by 6-in. air compressor or the main shaft of the mill.

The product is used for chicken grit and in the manufacture of porcelain and tile. Idle at the time of our visit but operations expected to resume in September, 1929.

*Riverside Portland Cement Company* formerly operated a deposit which was in the E.  $\frac{1}{2}$  of Sec. 29, T. 4 S., R. 2 W., S. B. M. It is 3 miles south of Lakeview on the north slope of the Lakeview Mountains.

The feldspar occurs in pegmatite veins in granite. Potash content varied from 10 to 12%. Product was shipped to the company's cement plant near Riverside.

Idle and presumably exhausted.

*Spicer Silica Property* is in T. 2 S., R. 4 W., and is  $3\frac{1}{2}$  miles east of Riverside and adjoins the Santa Fe Railway right-of-way on the east.

Two lenses of quartz in the granite have been exposed by small open cuts. The strike is N. 65° W. and dip 55° SW. In the quartz is a

thin bed of feldspar. These two lenses, having a maximum thickness of 3 feet, are about 10 feet apart in the granite and have been exposed for a length, along the dip, of 12 feet.

It was idle at the time it was visited.

*Stone Deposit.* C. P. Stone, 845 South Hill Street, Los Angeles, has been shipping feldspar and silica from a deposit which is 7 miles west of Riverside, in the Jurupa Mountains. Elevation 1300 feet.

The deposits occur on segregation zones in granite, which vary in width from 5 to 25 feet. These zones are roughly parallel, having a strike of N. 45° W. and dipping steeply to the northeast. They are separated by from 30 to 50 feet of granite.

The feldspar, which is orthoclase, occurs as masses completely enclosed in the clear, vitreous quartz.

A road has been built to the top of a hill where a deposit has been opened by a trench 10 feet deep by 80 feet long. The zone at this point has an average width of 6 feet. This, with some three or four smaller opencuts near the base of the hill, constitute all of the development work to date. Idle.

*Tully Deposit.* It is 3 miles south of Lakeview in Sec. 32, T. 4 S., R. 2 W., S. B. M., on the north slope of the Lakeview Mountains. Owner, W. M. Tully, Nuevo, California.

Large bunches of feldspar occur associated with pegmatite dikes in decomposed granite. The deposits are very irregular and appear to lie almost flat, probably broken over.

The largest deposit yielded about 2500 tons. The product was sold to the Riverside Portland Cement Company. Idle.

*Warren Deposit.* George R. Warren, Riverside, California, owns deposits of feldspar and silica situated in Sec. 21, T. 4 S., R. 2 W., S. B. M., in the Lakeview Mountains, 3 miles south of Lakeview. These deposits are at an elevation of 1800 feet.

They are segregations of feldspar and quartz in granite. These segregations have taken place in roughly parallel zones. The strike is N. 40° E. and the dip to the east varies from 20° at the surface to 50° in a tunnel which is approximately fifty feet below the outcrop. It is reported that the feldspar contained 10% potash and that the quartz runs 98% SiO<sub>2</sub>.

Development consists of many trenches, shallow cuts and a few short tunnels. The principal work seems to have been done on the northwest slope near the top of the hill. Here an opencut 70 feet deep by 25 feet wide and 50 feet long has been made. A tunnel driven from below has been connected with the floor of this pit by means of two raises which are approximately 25 feet in length.

A considerable tonnage must have been shipped from this property but no authentic record of the amount seems to be available. Idle.

#### GEMS

Gem minerals occur in Riverside County in the San Jacinto range of mountains. The principal gem mineral found in this area is tourmaline. The colors are pink, green and dark red. The tourmaline mines are described in detail by Dr. George F. Kunz in bulletin No. 37,

Gems, Jewellers' Materials and Ornamental Stones of California, pp. 57-58; also State Mineralogist's Reports XV, pp. 574-577.

The principal productive mines of this area are known as *California*, *Columbia*, *Fano* and *San Jacinto*. These mines are located on Thomas Mountain, near Coahuila.

There has been no production of tourmalines from this area in recent years.

It is reported that W. H. Houghton, 1017 First National Bank Building, San Diego, California, has a deposit of quartz crystals in the Coahuila Mountains.

#### GRANITE

This stone, which is widely distributed over Riverside County, has in the past been quarried for rubble used in breakwater at San Pedro and Long Beach and for curbing, building and ornamental purposes. The industry has declined sharply in the past few years, practically the only demand now being for rubble and ornamental stone.

It was quarried on a large scale at Casa Blanca for rubble, and for building and ornamental purposes at Corona, Riverside and Temecula. At Porphyry and Riverside it has been quarried for broken stone. The Casa Blanca quarries have long been idle.

*Blue-Gray Granite Quarry.* Under lease to E. Johnson, Val Verde, California. It is in T. 3 S., R. 4 W.,  $3\frac{1}{2}$  miles west of Val Verde. Owner, N. B. Walters, 28 South Chapel Street, Alhambra, California.

The rock is comparatively fine-grained granite having a very uniform mineral pattern, making it an ideal monumental stone, for which purpose it is used. Shipments are made at the rate of 250 cu. ft. per month. One man employed.

*Bly Brothers and McGilliard Company*, 230 Grosse Buiding, Los Angeles, are operating a quarry in Sec. 1, T. 2 S., R. 6 W., at the foot of the west slope of the Jurupa Mountains, 5 miles west of Riverside.

At present shipments of only 150 tons per month are made. These shipments go to Los Angeles where the rock is ground for use as roofing material and for chicken grit. Two men are employed.

Bibl: State Mineralogist's Report XV, p. 585.

*P. H. Coogan and Connally Brothers*, respectively, formerly operated two granite quarries near Elsinore.

The product which is a gray diorite was derived chiefly from surface boulders. Idle.

Bibl: State Mineralogist's Report XV, p. 586.

*Corona Rock Company* formerly operated a quarry in Secs. 8 and 17, T. 3 S., R. 6 W., S. B. M., also at Porphyry Station.

Bibl: State Mineralogist's Report XV, p. 585.

*Lane Brothers*, monument dealers of Los Angeles, formerly operated a quarry 3 miles east of Corona, loading at Alvord Station on the Santa Fe Railway.

Bibl: State Mineralogist's Report XV, p. 585.



*La Borde Brothers*, of Perris, California, controlled some quarries, now idle, between Perris and Elsinore.

*Ormand Quarry.* The *Hauser Construction Company*, K. B. Kumpe, vice president and general manager, Security Building, Long Beach, California, is operating this quarry which is in Sec. 9, T. 2 S., R. 5 W., on the Rubidoux Rancho, three miles west of Riverside. It is in the Jurupa Mountains.

The quarry is in one of the foothills, on the southwest slope of these mountains, which consist essentially of granodiorite. It is estimated that there are 15,000,000 tons of suitable stone in this hill.

The quarry was developed primarily for the purpose of supplying stone for the construction of the Long Beach Harbor breakwater point. This work was begun August 31, 1925 and nearly three miles of sea walls have been completed. To date 1,744,000 tons of this rock has been quarried, transported and placed in position for this work. It was quarried at the rate of 3000 tons per day from a quarry face which is approximately 45 feet high by 1000 feet long. Quarry run of rock up to 5 tons in weight was used for the core of the breakwater. This was armored on each side by large rock up to 15 tons in weight. It is believed that the rate at which this work was done has broken all American engineering records. The largest 8-hour placement was 4200 tons.

Five large-scale blasting operations supplied the nearly two million tons used. The first shot provided 175,000 tons, the second and third about 100,000 tons each, the fourth 600,000 and the fifth 1,000,000 tons. Four hundred and fifteen thousand pounds of 20% dynamite was used in this last shot. Six coyote holes 3 feet wide and  $4\frac{1}{2}$  feet high were driven into the hill, varying in length from 100 feet to 140 feet. Each of these was supplied with 3 crosscuts, from 30 to 40 feet apart. These crosscuts extended 30 feet on each side of the coyote hole. The results of the shot were highly satisfactory. Specifications called for a maximum weight of 15-ton pieces and a minimum of block hole shooting was required.

Broken rock is loaded onto flat cars by three steam shovels. Three locomotives are used for switching and spotting cars. Other equipment consists of drill sharpener and two 600-cu. ft. air compressors.

The camp when in full operation accommodated 150 men, with houses, commissary and sanitation.

In July, 1929, shipments were being made at the rate of 2500 tons daily.

Bibl: The Explosives Engineer, October, 1929.

*Temecula Quarries.* Two quarries which are two miles south of Temecula, were operated for many years. The most recent operations were conducted by M. Machado and Joseph Winkels. Idle.

Bibl: State Mineralogist's Report XV, p. 586.

#### GYPSUM

This material, the hydrous calcium sulphate, or sulphate of lime, is of much importance in construction, since the calcined product, plaster of paris, is the base of nearly all wall plasters for interior work. It also forms the base of the material known as staff which is so exten-

sively used in the construction of temporary buildings for exposition purposes. It is also important as a fertilizer in supplying lime and in correcting alkaline soils. In small quantities, it is used in the manufacture of Portland cement to retard its setting.

Gypsum occurs in several small areas on both sides of Gypsum Canyon about 2 miles south of Corona. The larger deposits are on the east side of the canyon, a short distance from its mouth. Other small deposits are said to occur in neighboring canyons west and southwest of Corona. These deposits have not been worked for years.

Bibl: State Mineralogist's Report XV, p. 579; Bull. No. 38, p. 286.

Extensive deposits of gypsum occur in the northeastern desert section of the county in the Palen Mountains, Maria Mountains, the McCoy Mountains and the Riverside Mountains.

The deposits in the Palen Mountains occur in a belt which is roughly 3 miles long and from 1 to  $1\frac{1}{2}$  miles wide. This belt which consists of gypsum interbedded with limestone, crosses the mountains in an east-west direction and is several thousand feet in thickness.

The gypsum is very pure and the beds are, in places, several hundred feet in thickness. It is finely crystalline and the color varies from transparent white to slightly reddish.

Extensive deposits of gypsum are found in both the Little Maria and the Maria Mountains. These deposits are 26 miles north of Blythe and 17 miles south of Blythe Junction (Rice). The belt here is approximately  $2\frac{1}{2}$  miles long,  $2\frac{3}{4}$  miles wide at the east end and one mile wide at the west end. It has an east-west strike and a variable dip to the north.

*Garland Deposit.* Garland, of Los Angeles, has a gypsum deposit in the Maria Mountains, 3 miles east of Cox Siding on the Santa Fe Railroad branch line from Blythe Junction (Rice) to Ripley.

This deposit is 22 miles north of Blythe. Nothing but assessment work has been done.

*Garbutt and Orcutt Deposit.* This is on the west slope of the Little Maria Mountains, 26 miles northwest of Blythe. It comprises 620 acres in Secs. 2, 3 and 10, T. 4 S., R. 20 E., S. B. M., divided into 5 claims, The Standard Gypsum Claim, the Standard Gypsum Nos. 2, 3, 4 and 5 claims, all patented. Elevation 1200 feet. Owners, Frank A. Garbutt, 411 West Seventh Street, Los Angeles, and W. W. Orcutt, 403 South Mariposa Avenue, Los Angeles.

The deposit is composed of three principal strata 20, 40 and 60 feet thick, respectively. They are separated by beds of limestone. The strike is slightly north of west and they dip to the north at comparatively steep angles, probably  $40^{\circ}$  to  $45^{\circ}$ . The outcrop is traceable for the full length of the property. It is a continuation of the U. S. Gypsum Company's deposit, which it adjoins, on the west.

C. M. Langdon, of Los Angeles and P. D. McIntyre, Blythe, California, have gypsum deposits in the Ironwood Mining District, on the west slope of the Maria Mountains. They are 20 miles north of Blythe and 2 miles east of the Santa Fe Railroad. This property comprises 4 claims, Langdon, Langdon Nos. 1, 2 and 3.

The gypsum is very pure, crystalline and compact. It is pure white in color. No shipments have been made as only assessment work has been done.

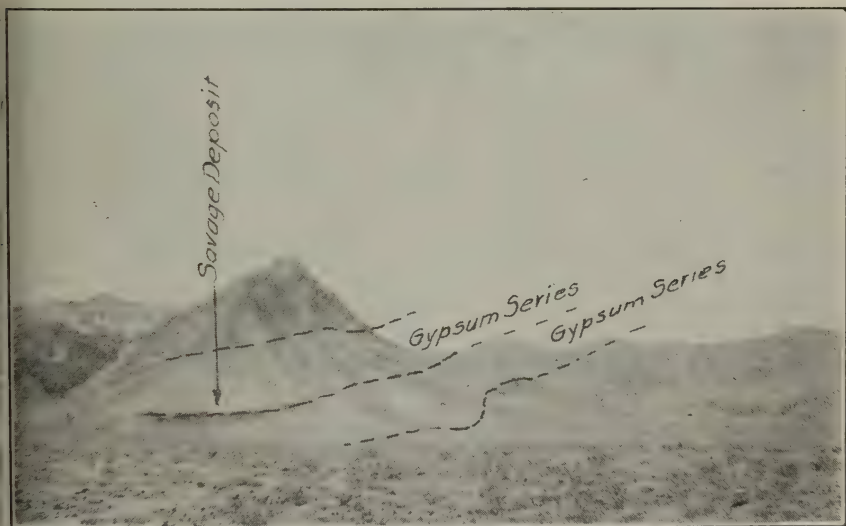
*E. A. Parkford*, Pacific Mutual Building, Los Angeles, and *J. M. Wilson, Vidal*, California, are the owners of a gypsum deposit which is located in NW $\frac{1}{4}$  of the SW $\frac{1}{4}$  of Sec. 7, T. 2 S., R. 24 E., S. B. M., on the Colorado River Indian Reservation and on the east slope of the Riverside Mountains, about 7 $\frac{1}{2}$  miles south of Vidal.

The following data were largely obtained from a report on this property by Smith, Emery & Company, of Los Angeles:

The main deposit forms a low hill about 250 feet high and 400 feet in width at the base. This hill extends southeasterly from a deep gulch a distance of 700 feet where it merges into an east-west ridge which is 400 feet higher than the gulch. The gypsum hill consists of massive beds of gypsum interbedded with some limestone. It is estimated that the gypsum constitutes 80% of the total. Some of the beds are more than 50 feet thick and contain no seams of foreign material. These deposits extend southerly for a distance of approximately 700 feet into a cross ridge. South of this ridge it appears in three hogbacks extending about 600 feet and containing 3 gypsum beds aggregating 70 feet in thickness. Toward the southern end the interbedded limestone predominates. The deposits dip to the west at angles of from 30 to 60°. It is a very good grade of gypsum, analyses of numerous samples indicating an average of 98%.

Development consists of opencuts and five tunnels 198, 40, 27, 26 and 20 feet long, respectively. Nothing but assessment work is being done.

*Savage Deposit.* This deposit is at the foot of the west slope of the Maria Mountains, 20 miles north of Blythe and 2 miles east of Cox

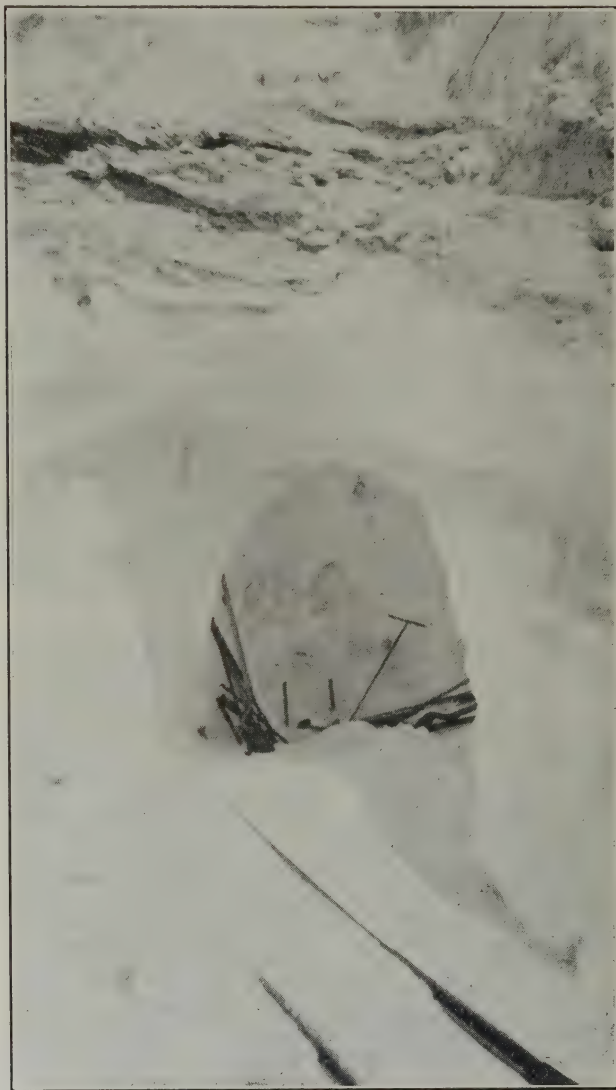


Savage Gypsum Deposit, two miles south of Midland, Riverside County.  
Photo by Mr. Ray Savage.



Siding on the Santa Fe branch from Blythe Junction (Rice) to Ripley Owner, Ray T. Savage, Los Angeles.

This deposit consists of two beds of gypsum which are separated by a bed of limestone some 30 to 50 feet in thickness. The strata here



Savage Gypsum Deposit, two miles south of Midland, Riverside County. Gypsum beds 30 feet thick. Photo by Mr. Ray Savage.

dip to the northwest at an angle of approximately  $20^{\circ}$ , apparently passing under the unconsolidated material forming the floor of the valley between the Maria Mountains and the Little Maria Mountain to reappear in the latter range at the mine of the U. S. Gypsum Company.

pany, which is some four miles to the northwest. These two beds have an aggregate thickness of approximately 70 feet, which is about equally divided between the two. The gypsum is crystalline, white and compact and shows little or no iron stain.

Principal development consists of a 40-foot tunnel driven in a southeasterly direction and chambered to a width of about 20 feet. From this opening it is reported that three cars were shipped. A small crushing plant, now dismantled, was located at the mouth of the tunnel. At Cox Siding, which is 2 miles west of the deposit, a bin and elevator for loading into freight cars has been built. Nothing but assessment work is being done.

Analysis made by Monolith Portland Cement Co.:

Silica ( $\text{SiO}_2$ )	1.54%
Lime ( $\text{CaO}$ )	2.39%
Magnesia ( $\text{MgO}$ )	Trace
Moisture	1.86%
Hydrated gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	92.72%

Selected Sample: Hydrated gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} = 99.15\%$ ).

*United States Gypsum Company*, 816 West Fifth Street, Los Angeles, is working deposits of gypsum in T. 3 S., R. 21 E., and T. 4 S., R. 21 E., in the Little Maria Mountains, 23 miles northwest of Blythe. These deposits are 2 miles west of the Santa Fe Railway branch from Rice (Blythe Junction) to Ripley. Elevation about 1150 feet.

The gypsum here occurs interbedded with limestone and amphibolite schist. The strike varies from north-south at the south end to N.  $45^\circ$  E. at the north end. The dip varies both in direction and amount. This is due to intense folding. At the north end of the present workings it varies from a low angle to the east to a very steep angle to the west. At the south end it is about  $75^\circ$  to the west.

On the west is a bed of limestone some 200 feet in thickness. Beyond this are the schists and intrusive rocks of this area. To the east is an amphibolite schist, containing considerable quartz, the thickness of which is several hundred feet. This is succeeded by beds of limestone and gypsum. This company has other deposits which lie approximately one-half mile to the east of their present workings.

This whole series is faulted, the northern portion having been moved some 60 feet to the east. Another and similar fault occurs about five-eighths of a mile to the south and there is at least one other such fault between this point and the northern end of the Garbutt and Orcutt deposit, which is approximately 2 miles southwest.

The gypsum probably was deposited from evaporating waters and apparently was laid down in disconnected bodies on an uneven bottom, was then elevated, folded and faulted, resulting in lenses which are as much as 2000 feet long by 40 to 60 feet wide. Much smaller lenses also occur. At the ends these lenses appear to split (much as does an ore shoot) into thin layers of gypsum and limestone.

Both isolated bunches and continuous strata of anhydrite are encountered. These may be found at almost any horizon in the deposits, due no doubt to the intense folding. The gypsum is white, crystalline, compact and of very good quality. The lens on which present work is being concentrated is approximately 2000 feet long, and 45 feet wide.

Development work consists of the present working pit which is about 400 feet long and 45 feet wide, with an average depth of 30 feet. The

dip in this pit is about  $75^{\circ}$  to the west. There is practically no overburden. At the entrance to this pit, which is at the north end, a shaft has been put down on an inclination of  $27^{\circ}$ , a distance of 80 feet. This is to be used eventually for the removal of the gypsum below the present quarry floor. This shaft is equipped with gasoline hoist and the surface tram cars are used for skips. Some 400 feet north of this pit there is another opencut which is 75 feet long, 40 feet wide and 25 feet deep. The bottom of this cut is connected to two tunnels below by means of raises. These two tunnels are driven in a southwesterly direction, each about 150 feet in length. They are at the level of the narrow-gauge track system over which the gypsum is hauled to the plant. Still farther north, a distance of 300 feet, another shaft has been sunk 250 feet on a  $30^{\circ}$ -incline. The course of this shaft is N



U. S. Gypsum Plant at Midland, Riverside County, California.  
Photo by courtesy Albin K. Becher.

$45^{\circ}$  E. The upper 80 feet is an opencut, the shaft having been sunk from the bottom of an inclined open pit. Some 300 feet north of this shaft, a vertical shaft was sunk to a depth of 150 feet.

About 450 feet north and east from the vertical shaft a lens of gypsum, which lays against the amphibolite schist has been worked. This open pit is 200 feet long and 30 feet wide, with an average depth of 30 feet. The face in the present working open pit is drilled by hand churn drills and blasted. Large pieces are block-holed with jack hammers. A Bucyrus Diesel type D-Z shovel loads the rock into 3-ton side dump cars. Trains of these cars are hauled to the plant by one 7-ton and one 10-ton Whitecomb gasoline motor.

At the plant the material is delivered to a jaw crusher, elevated and ground in two Raymond mills, thence to two calcining kettles. After calcining, it is reground in tube mills and Buhr stone mills. Th



making plant is equipped with a Bates packer. The calcining part of the plant was put in operation August 15, 1928. The crushing plant has been in operation since 1925.

Power plant consists of one 1-cylinder Fairbanks-Morse 60-h.p. semi-Diesel engine which operates air compressor and lighting unit. One cylinder, 360-h.p. Fairbanks-Morse full Diesel engine; one 4-cylinder 100-h.p. type Y, semi-Diesel, Fairbanks-Morse engine. The plant has capacity of 300 tons of finished products daily.

The products are wall plaster, finishes and casing plaster. Raw gypsum is sold to the cement companies and for agricultural purposes. A small quantity is also supplied to the moving picture industry for use in the filming of snow scenes. About 50 men are employed.

*John Webb*, of Vista, California, also has deposits of gypsum in the mountains on which nothing but assessment work has been done.

#### LIMESTONE

In Riverside County crystalline limestone occurs at many points in the area of metamorphic rocks. Extensive deposits occur north of the city of Riverside, near the county boundary line of Riverside and San Bernardino counties. These deposits are owned by the Riverside Portland Cement Company and have been developed and used by this company in the manufacture of cement.

Commercial deposits of limestone occur in the San Jacinto range of mountains and in the vicinity of Whitewater. In the eastern section of the county in the McCoy and Santa Maria Mountains, deposits of crystalline limestone are found with the slates, schists and quartzites that make up the rocks of these mountain ranges.

#### Deposits.

*Eden Hot Springs Limestone Deposit.* This deposit of limestone is located in Sec. 23, T. 3 S., R. 1 W., S. B. M., just east of Eden Hot Springs, on the western slope of the San Jacinto range of mountains, about 10 miles northwest of San Jacinto. Owner, Eden Hot Springs, Inc.

The belt of limestone strikes northwest and southeast. The limestone is white in color, coarsely crystalline and reported to carry 98% calcium carbonate. Idle.

*Guiberson Limestone Deposit (Whitewater).* The property is located SE $\frac{1}{4}$  of Sec. 22 and SW $\frac{1}{4}$  of Sec. 23, T. 3 S., R. 3 E., S. B. M., one-half mile south of Whitewater, a station on the Southern Pacific Railroad. Holdings comprise 160 acres, patented. Elevation 1200 feet. Owner, S. H. Guiberson, Los Angeles.

The Whitewater limestone contains occasional intrusions of diorite, probably offshoots from the Jurassic batholith forming the San Jacinto mountain. The rock contains some hornblende, very little mica and subordinate amounts of quartz. The limestone belongs to the Carnianiferous age. The bedding planes of the limestone dip S. 42° to 65° E., and the beds strike N. 30 to 40° W. Back of the belt of limestone there is a stratum of mica schist which dips 65° SW. The thickness varies from 8 to 20 feet. On contact of the mica schist is a zone of albite-feldspar, with a high silica content, classified as quartz-

diorite. The feldspar deposit varies in width up to 200 feet and lies against the diorite of the San Jacinto batholith. Estimated tonnage of limestone is 100,000,000 tons.

Development consists of three tunnels driven south from the San Geronimo wash, and a number of opencuts.

Analysis of limestone is as follows:

Silica ( $\text{SiO}_2$ )	0.74 %
Aluminum ( $\text{Al}_2\text{O}_3$ )	0.004 %
Iron ( $\text{Fe}_2\text{O}_3$ )	0.008 %
Lime ( $\text{CaO}$ )	53.29 %
Magnesia ( $\text{MgO}$ )	2.39 %

Idle.

*Hubbard Limestone Deposit.* The deposit is located in T. 3 and 4 S. R. 1 W., 4 miles northwest of San Jacinto, at an elevation of 2600 feet. It is just east of the road from Soboba Hot Springs to Gilman's Reliance Hot Springs. Owner, Omar H. Hubbard, Hubbard Building, Long Beach, California.

This property was formerly owned and operated by the Snowflake Lime Company. It was equipped with a steel shell lime kiln which is still on the property. The strike of the deposit is N.  $40^\circ$  W. and the dip is to the northeast. It is crystalline limestone of a very good grade. This is probably part of a deposit which outcrops intermittently from this point, in a northwesterly direction to a point in Coyote Pass. The outcrop has also been noted at Eden Hot Springs in Sec. 23, T. 3 S., R. 1 W.

Approximately one thousand feet above the road, in the head of a very steep canyon, an opencut has been made in the limestone. The opencut now presents a face 20 feet high by 75 feet long. The broken rock was allowed to roll down the canyon to the kiln. Idle.

*Mathews Limestone Deposit.* The deposit is situated in the Jurupa Mountains, seven miles west of Riverside. Owner, W. B. Mathews, 1032 North Oakland Street, Pasadena, California.

The deposit is a crystalline limestone having an approximate thickness of 80 feet. The strike is east and west and it dips steeply to the south. The belt of limestone is in granite. Shipments of 150 tons per week are made to Los Angeles, where it is ground for chicken feed. Shipments to date amount to 500 tons. Two men are employed.

*Moore Limestone Deposit.* The deposit is situated in Babbitt Canyon,  $11\frac{1}{2}$  miles east of Hemet. Owner, J. S. Moore, Winchester, California.

The quarry is 20 feet high by 50 feet in length. The rock quarried is allowed to roll down the hillside to the top of a gravity tram. Here the rock is loaded into cars and lowered to the level of the road. Idle.

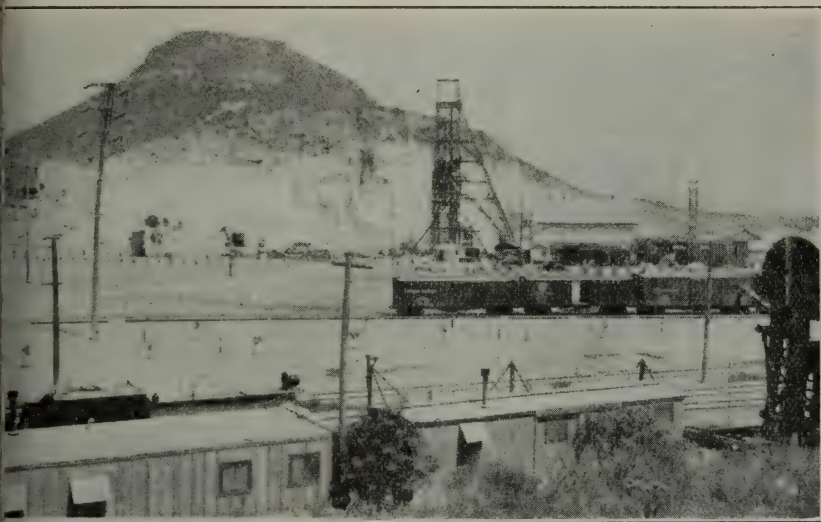
*Novelle Limestone Deposit.* The deposit is situated in Sec. 26, T. 3 S. R. 3 E., S. B. M., 2 miles south of Whitewater. Holdings comprise 6 acres. Owner, George A. Novelle, Monrovia, California.

The stratum of limestone is about 500 feet in thickness, strikes  $40^\circ$  W. and dips  $40^\circ$  to the southeast. The limestone is cut by intrusions of diorite. On the west side of the deposit there is a narrow belt of mica-schist which strikes north and south and dips  $40^\circ$  E.

The belt can be followed along its outcrop which attains a height 500 feet above the plain of the valley for a distance of 2500 feet easterly to the wash of Blaisdell Canyon. The limestone is blue gray in color and coarsely crystalline. Idle.

*Riverside Portland Cement Company*, John Treanor, president, 724 South Spring Street, Los Angeles. This is also the business address of the company. Quarry and works at cement plant near Crestmore; MacDonald, general superintendent; A. C. Robotham, superintendent, Mining Department.

This company's main quarry and cement plant is 5 miles northwest of Riverside in Secs. 3, 5 and 6, T. 2 S., R. 5 W., S. B. M. The blue, coarsely crystalline limestone is quarried in a butte similar to many which occur in this district, but which generally are composed of granite. The limestone bed strikes N. 30° W. and dips to the east.



Quarry with steel headframe, Riverside Cement Co., near Crestmore, Riverside County.

The dip of the level of the present quarry floor is approximately 45° while below this level, underground work has shown that this increases to 80°, and at still greater depth it again decreases to 40°. The capping or hanging wall is decomposed granite, the footwall is granodiorite.

This deposit is remarkably pure, analysis showing it to contain a lime carbonate equivalent to 99.73% with 0.30% magnesia and only a trace of iron. The footwall rock is quarried and used to supply the aluminous material necessary for the manufacture of cement.

The raw mixture of limestone and granodiorite has the following composition:

Silica	15.18%
Iron oxide and alumina	5.06%
Lime	76.34%
Magnesia	2.90%
Total	99.48%



After burning and grinding, the finished cement gives the following average analysis:

Silica	22.98 %
Iron oxide and alumina	8.80 %
Lime	63.10 %
Magnesia	2.42 %
Sulphuric anhydride	1.42 %
Total	98.72 %

The quantity of limestone remaining above the quarry floor level in the fall of 1927, had become so small that the company started work on the development of an underground system of mining for the removal of the limestone beneath this horizon.

It was decided to adopt a block caving system similar to that which has been developed by and so successfully applied at the Inspiratic Consolidated Copper Company's mine and by the Ray Consolidated Copper Company, at Ray, Arizona.



Cement mill and Cottrell precipitation plant. Riverside Cement Co., Riverside County.

A 5-compartment shaft was sunk in the footwall to a depth of 350 feet. The collar of this shaft is in the quarry floor at its west end. Levels have been driven at 100, 200, 240 and 280 feet, the last name being a pump station level only.

While details of the system to be used are not available at this time in general, such a system involves the driving of a 'fringe drift' completely around the edge of the orebody to be caved. At intervals of about 50 feet, parallel crosscuts are driven through the ore connecting opposite sides of the fringe drift. This forms the haulage level and it is usually placed at such an elevation that there will be a solid block of ground between this level and the bottom of the block to be caved. The block is then isolated from the surrounding rock by means of cut-off stopes. Raises at stated intervals are put up from the crosscuts and branch raises driven from these. In this manner the entire

block is undermined and eventually all support is removed, allowing it to cave into the raises. It is then drawn into cars through chutes on the haulage level.

The shaft has two skip compartments, pipe compartment and manway compartment. In the fifth compartment there is installed an Otis elevator for hoisting men and materials. The pumping plant is equipped to handle 12,500 gallons of water per minute, through a 28-in. discharge line.

Mine surface plant consists of 110-foot steel headframe; hoist house and engine room; warehouse; blacksmith shop; electric shop; wood-framing shed; all of steel frame construction, covered with corrugated iron; rescue station; change house (300 men) and office building, all constructed of concrete; Wellman-Seaver-Morgan double-drum (8-ft. dia.) hoist, driven by 350-h.p. motor; two 3000-cu. ft. Ingersoll-Rand air compressors, each driven by 500-h.p. motor; drill sharpener; wood-framing machines, etc.

Rock is hoisted in 5-ton skips and the plant has a capacity of 3000 tons daily. It is believed now that by January 1, 1930, all quarrying operations will cease and that the mine will then supply all of the limestone to the cement plant.

This company also has limestone quarries 5 miles west of the Crestmore plant. Quarry No. 6 is on the east slope of a hill in the Turupa Mountains. It is in a white crystalline limestone which has northwest-southeast strike and dips  $40^{\circ}$  to  $50^{\circ}$  to the east. Crosscut tunnels show the deposit to be 100 feet thick.

Quarry known as No. 5 is on the south slope of a hill adjacent to Quarry No. 6 on the north. Here there is a quarry face 200 feet high by 1000 feet long. This quarry is now practically exhausted and has not been worked since 1927.

#### CEMENT PLANT

This plant, which now has a capacity of 8000 barrels daily was fully described in State Mineralogist's Report XV, pp. 557-559. Since this description was written, a plant to utilize the waste heat from the kilns has been built. It consists of 3 Sterling boilers and one Kidwell boiler, having a capacity of 1000 horsepower each; two 3000-k.w. General Electric turbine generators and condenser plant. The entire plant requires only 2000 k.w. for its operation. Waste heat gases go to the boilers at a temperature of  $1300^{\circ}$  and pass out the flue to the Cottrell precipitation plant at  $400^{\circ}$ .

There has also been added a nest of concrete silos for cement storage. These have an aggregate capacity of 200,000 barrels.

About 850 men are employed.

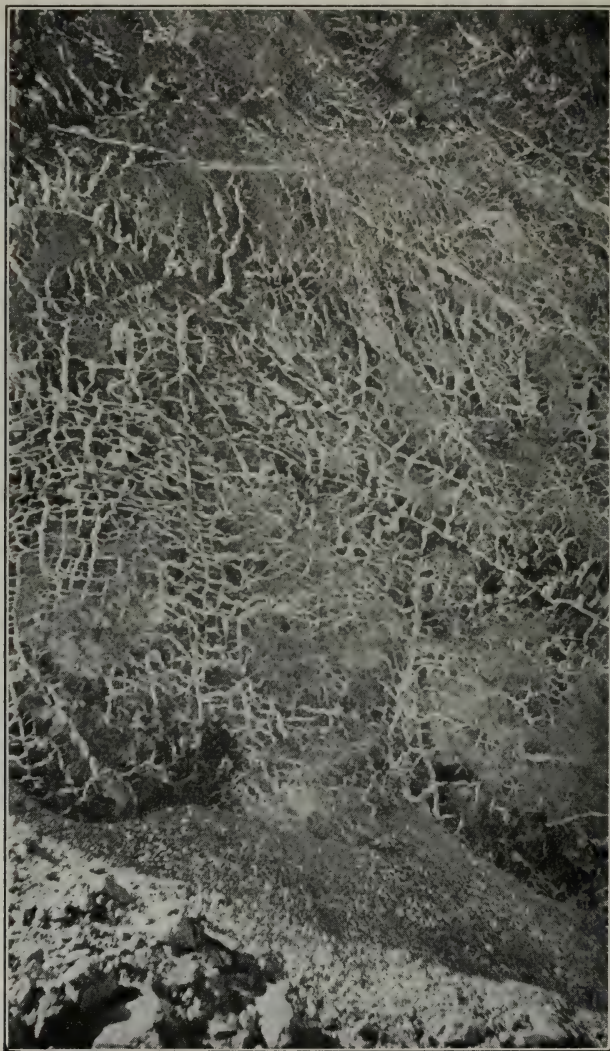
Bibl: State Mineralogist's Reports XV, pp. 553-559; XVII, pp. 324-325.

*San Jacinto Rock Products Company's Limestone Deposit.* The deposit is located in Babbiste Canyon, 12 miles east of Hemet. It is on the southwest side of the canyon, at an elevation of 2000 feet. Owner, San Jacinto Rock Products Company; G. W. Green, president, San Jacinto, California.

This deposit of crystalline limestone is 30 feet wide, has a northwesterly strike and dips at an angle of  $40^{\circ}$  to the southwest. Its outcrop



is traceable for one-half mile between granite walls. The present quarry is a sidehill cut, having a face 30 feet high by 100 feet long. The rock from the quarry is loaded into trucks and hauled to the company's grinding plant in San Jacinto. The product is used for chicken feed. Production to date is 500 tons.



Winchester Magnesite Deposit. Stock-work of veinlets of magnesite.  
Photo by C. A. Waring.

*Schellenger Limestone Deposit.* The deposit is situated in the Maria Mountains, 28 miles north of Blythe. Holdings comprise nine 160-acre placer locations. Owners, E. E. Schellenger and associates, of Blythe, California.



It is reported that the belt of limestone averages 200 feet in thickness. It is coarsely crystalline; color white to gray. Analysis 98.45%  $\text{CaCO}_3$ , magnesia 0.25%.

Nothing but assessment work has been done.

*Southern Pacific Company's Limestone Deposit.* The deposit is situated in Secs. 23 and 25, T. 3 S., R. 3 E., S. B. M., one mile south of Whitewater, a station on the Southern Pacific Railroad. Elevation 100 feet. Owner, Southern Pacific Company.

The beds of crystalline limestone contain numerous intrusions of granite and strata of mica schist from 8 to 20 feet thick. The stratum of limestone which is of the carboniferous series, is from 400 to 600 feet in thickness. The rock is a coarse, crystalline limestone of high calcium carbonate content, reported to carry 98% calcium carbonate. The belt of limestone strikes northwest, coursing through sections 23, 24 and 25, T. 3 S., R. 3 E. It is parallel to the stratum of limestone in the Guiberson Deposit. Undeveloped.

#### MAGNESITE

*Hemet Magnesite Mine.* Property is  $3\frac{1}{2}$  miles north of Winchester, Sec. 31, T. 5 S., R. 1 W., S. B. M. Former owner, *Magnesco Refractory Products Company*. Present owner, Ray Boswell, Trustee, 140 South Main Street, Los Angeles.

Magnesite occurs as a stockwork of veins in a zone of serpentine about 200 feet wide, extending northerly for probably 1000 feet. The deposit is developed by a large open cut or glory hole. A cross cut at lower elevation is connected with the glory hole by a series of raises. The property was equipped with a 30-ton treatment plant, but all the machinery has been removed and resumption of operations is not contemplated.

Bibl: State Mineralogist's Reports XV, p. 579; XVII, pp. 327-328; Bull. No. 79, pp. 61-65; U. S. Geol. Survey Bull. 355, pp. 38-39; Bull. 540, pp. 516-519.

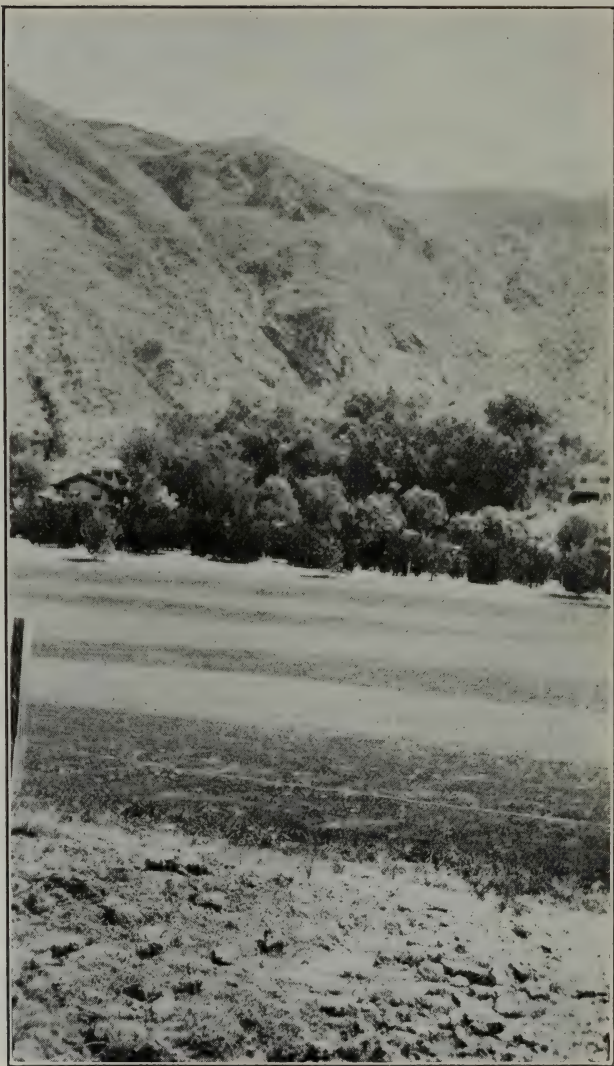
#### MINERAL SPRINGS

The mineral springs of Riverside County, on account of their curative properties, attract many people to the hotels which are operated in connection with them. A number of these have been very popular for many years and their patronage is still good.

Some of the most noted of these are Glen Ivy, Elsinore and Murrietta, all of which occur along the fault line of the Temescal Valley. Several thermal springs in the vicinity of Elsinore were absorbed in establishing the city's water supply. Lakeview Inn and Bundy's Hotel are operated in connection with some of the remaining springs.

#### *Analyses of Water from Lakeview Inn Hot Springs*

	Original Hot Springs, grains per gallon	White Sulphur Springs, grains per gallon
Total residue by evaporation	19.82	19.40
Insoluble in water after evaporation	13.12	11.83
Soluble in water after evaporation	3.79	5.24
Organic matter and chemically combined water	2.91	2.33
Insoluble parts consist of—		
Sodium and potassium sulphates	7.07	4.09
Sodium chloride (common salt)	3.38	5.07



Soboba Hot Springs, San Jacinto, Riverside County.

	Original Hot Springs, grains per gallon	White Sulphur Springs, grains per gallon
Sodium carbonate (sal soda)-----	2.67	2.67
The insoluble parts consist of—		
Calcium sulphate (gypsum)-----	1.92	2.33
Calcium and magnesium carbonates }-----		
Silica-----	1.87	2.91

A partial analysis of the waters of Bundy Hot Springs, made by the California State University, is as follows:

*Partial Analysis of water from Bundy Hot Springs*

	Grains per U. S. gallon
Sample clear with taste of sulphuretted hydrogen.	
Sodium and potassium sulphates (Glauber's salts)-----	5.02
Sodium chloride (common salt)-----	1.64
Sodium carbonate (sal soda)-----	6.19
Calcium and magnesium carbonates and calcium sulphate-----	2.04
Silica-----	3.51
Organic matter and chemically combined water-----	.88

Temperature 112° F.

*Murrietta Hot Springs.* The largest and hottest spring is at Siloam. The water has a temperature of 170° F. The analysis of the waters from this spring shows the following:

*Analysis of Water from Murrietta Hot Springs*

	Constituents per 100,000	Grains per gallon
Sulphate of lime-----	2.14	1.25
Carbonate of lime-----	.69	.40
Carbonate of magnesia-----	trace	trace
Iron-----	.52	.30
Soluble silicate-----	6.00	3.50
Chloride of sodium-----	60.10	35.00
Carbonate of sodium-----	2.83	1.65
Hydrogen sulphide and carbonic acid-----	5.15	3.00
	77.43	45.10

Along the western base of the San Jacinto mountain range is another fault, the line of which is marked by several hot springs. The most notable of these are *Eden Hot Springs*, which is 9 miles northwest of the town of San Jacinto. There are twenty-three flowing springs. The hottest water has a temperature of 126°. The Eden Hot Springs, Inc., Mr. Conrad, president, 945 Wall Street, Los Angeles, is now building a hotel, cottages, etc. at these springs. *The San Jacinto or Relief Hot Springs* and the *Richey or Soboba Hot Springs* have long been noted as health resorts. At the eastern base of these mountains is *Palm Springs*. By reason of an extensive construction campaign which was completed in 1927, this is probably the widest known resort in Riverside County.

For a complete description of the mineral springs of this district, the reader is referred to U. S. Geol. Survey Water Supply Paper No. 338, by Gerald A. Waring, 1915.



## CRUSHED ROCK

*Temescal Rock Quarry.* The quarry is located in Temescal Canyon 4 miles southeast of Corona.

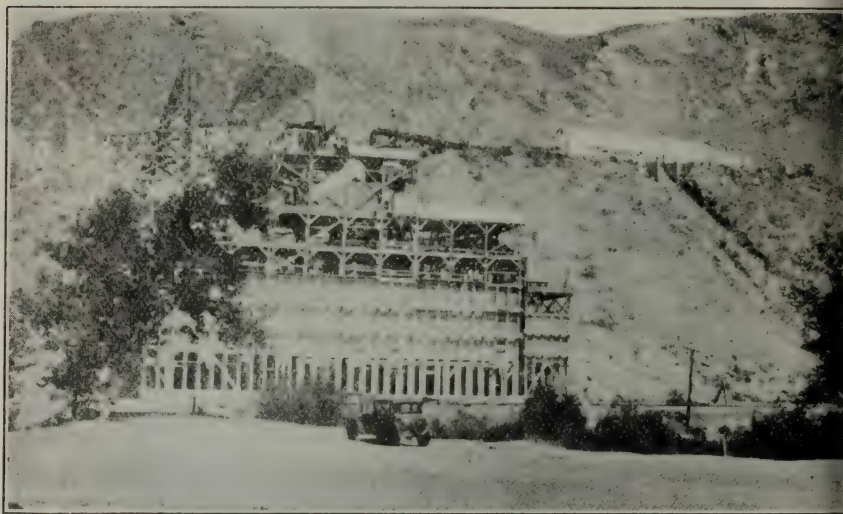
This quarry was operated by the *Blue Diamond Company*, of Los Angeles, until 1927, when the plant was destroyed by fire. Idle.

Bibl: State Mineralogist's Reports XVII, pp. 331-332; XV, pp. 586-587.

## SLATE

*Rainbow Mining and Mineral Products Company.* This company formerly operated a deposit on what is known as the Rainbow Group of Mines. It is 3 miles north of Elsinore.

Here a slate belt having a strike of N. 40° W. and dip 50° SW. contains parallel beds of dark, siliceous slates, together with red, yellow



Temescal Rock Quarry, Blue Diamond Company, Corona, Riverside County.

and brown-colored slates. The individual beds vary in thickness from 6 to 8 feet.

Development consists of open cuts and tunnels on the various deposits.

Property is equipped with 20-ton grinding plant. Product was used for roofing purposes. Idle.

*Riverside Quarries Company*, 100 East Colorado Street, Pasadena California, formerly quarried slate in Armantrout Canyon, four miles south of Perris. The product was shipped to Los Angeles and vicinity where it was used as flagstones.

The slate forms the east slope of a low hill on the west side of a canyon. There is an open cut 200 feet long, 15 feet wide and 12 feet deep. Idle and apparently abandoned.

## SALINES

*Salton Salt Works.* This plant is located on the north end of the Salton Sea, 6 miles southeast of Mecca. The property consists of 2139



Salton Salt Works. Evaporating ponds at right. Mecca, Riverside County, California. Photo by courtesy of Seth Hartley.

acres, comprising 5 miles of shore line and extending about one-half mile north from the sea. Elevation approximately 260 feet below sea level. Owner, Seth Hartley, Mecca, California.

Previous to the influx of the Colorado River, which began in 1903 the New Liverpool Salt Company had worked deposits of salt which were found on the dry bed of the Salton Sink. These beds of pure salt are reported to have a thickness of from 10 to 20 inches. Since the inundation of this plant no work had been done here until July 10, 1927, when Hartley began his experiments on the recovery of salt from the water of the sea. He found that five years ago the water carried from 7 to 12% of salt and that at the present time this has increased to from 12 to 22%. Since United States government reports show that evaporation here varies from 87 to 129 inches per annum, with an annual rainfall return of 1.84 inches, Hartley decided to recover the salt by means of evaporation.



Salton Salt Works. 1500-ton harvest. Salton Sea, Mecca, Riverside County.  
Photo by courtesy of Seth Hartley.

There have been constructed along the shore, 4 evaporating ponds which cover 250 acres. These are connected with the sea by means of long, narrow channels. The water is either pumped into the ponds or they are filled by the wind storms which force breakers into the narrow channels. When evaporation has progressed to such a point that the solution is saturated, it is pumped into the precipitation vats, which cover an area of 12 acres. From 4 to 6 inches of brine is kept on the salt crystals to prevent precipitation of objectionable minerals. Harvesting is done at any time.

Present capacity is limited by the precipitation vats to 12,000 tons per year. It was harvested for the first time on September 29, 1929, at which time 1500 tons of salt were removed from the vats.

It is reported that analyses of this salt show that it contains 99.01% NaCl, 0.03% insoluble, 0.12% CaO and 0.14% MgO.

Two to twenty men are employed.



## OIL FIELD DEVELOPMENT OPERATIONS

R. D. BUSH, State Oil and Gas Supervisor

From June 30, 1929, to and including September 28, 1929, the following new wells were reported ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
<b>LUSA COUNTY:</b>					
rover Herring.....	23	14	5	1	-----
axwell Oil Co.....	31	17	2	1	-----
<b>ESNO COUNTY:</b>					
etroleum Securities Co.....	28	20	16	Gatcheli 1	Coalinga
tandard Oil Co.....	33	21	17	278	Kettleman Hills
ceanside Oil Co.....	32	22	16	3	-----
io Grande Oil Co.....	14	13	17	Mosesian 1	-----
hell Oil Co.....	15	19	18	Boston Land	-----
				Co. G	-----
hell Oil Co.....	6	20	18	Boston Land	-----
				Co. E	-----
hell Oil Co.....	11	20	18	Boston Land	-----
				Co. F	-----
estern Gulf Oil Co.....	9	18	18	5	-----
<b>RN COUNTY:</b>					
ne Ohio Oil Co.....	30	28	21	28	Belridge
he Ohio Oil Co.....	30	28	21	29	Belridge
he Ohio Oil Co.....	30	28	21	30	Belridge
he Ohio Oil Co.....	30	28	21	31	Belridge
he Ohio Oil Co.....	30	28	21	32	Belridge
eneral Petroleum Corp.....	22	29	27	Hensley 4	Fruitvale
hell Oil Co.....	27	29	27	Brackenbury 1	Fruitvale
estern Gulf Oil Co.....	22	29	27	9-KCL-B	Fruitvale
estern Gulf Oil Co.....	27	29	27	Switzer	Fruitvale
estern Gulf Oil Co.....	28	29	27	2-KCL-C	Fruitvale
agey Petroleum Corp.....	28	27	27	Agey 1	Kern River
ishop Corp.....	23	28	27	7	Kern River
P. C. M. O. Co.....	23	28	27	27	Kern River
P. C. M. O. Co.....	23	28	27	28	Kern River
eneral Petroleum Corp.....	14	28	27	10	Kern River
eneral Petroleum Corp.....	14	28	27	Wetmore 2	Kern River
eneral Petroleum Corp.....	14	28	27	Wetmore 8	Kern River
an American Petroleum Co.....	22	28	27	9	Kern River
an American Petroleum Co.....	22	28	27	14	Kern River
an American Petroleum Co.....	22	28	27	16	Kern River
an American Petroleum Co.....	22	28	27	21	Kern River
P. C. M. O. Co.....	8	32	23	85	Midway
onolulu Consolidated Oil Co.....	8	32	24	31	Midway
onolulu Consolidated Oil Co.....	8	32	24	41	Midway
onolulu Consolidated Oil Co.....	8	32	24	73	Midway
Richfield Oil Co.....	34	32	24	Calivada 4	Midway
tandard Oil Co.....	1	32	23	124	Midway
tandard Oil Co.....	1	32	23	220	Midway
tandard Oil Co.....	5	32	24	15	Midway
tandard Oil Co.....	5	32	24	52	Midway
tandard Oil Co.....	7	32	24	117	Midway
The Texas Co.....	21	31	22	B-4	Midway
Robert Bowles Oil Co.....	24	27	28	1	Mt. Poso
uttram Oil Co.....	23	17	28	Glide 1	Mt. Poso
eneral Petroleum Corp.....	21	27	28	Glide 21 15	Mt. Poso
Pacific Western Oil Co.....	15	27	28	Glide-Vedder 3	Mt. Poso
Pacific Western Oil Co.....	22	27	28	King 3	Mt. Poso
Pacific Western Oil Co.....	22	27	28	King 4	Mt. Poso
Pacific Western Oil Co.....	22	27	28	Rench 4	Mt. Poso
Pacific Western Oil Co.....	22	27	28	Rench 5	Mt. Poso
Petroleum Securities Co.....	21	27	28	Glide 17	Mt. Poso
Petroleum Securities Co.....	25	27	28	Glide-Vedder 1	Mt. Poso
ignal Oil & Gas Co.....	27	27	28	7	Mt. Poso
The Texas Co.....	4	27	28	Alta Vedder 3	Mt. Poso

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>KERN COUNTY—Continued.</b>					
Union Oil Co.-----	4	27	28	S. & M. 4	Mt. Poso
Union Oil Co.-----	4	27	28	S. & M. 5	Mt. Poso
Union Oil Co.-----	4	27	28	S. & M. 6	Mt. Poso
Union Oil Co.-----	28	27	28	Tribe 3	Mt. Poso
Union Oil Co.-----	28	27	28	Tribe 4	Mt. Poso
Union Oil Co.-----	28	27	28	Tribe 5	Mt. Poso
Union Oil Co.-----	28	27	28	Tribe 6	Mt. Poso
Union Oil Co.-----	28	27	28	Tribe 7	Mt. Poso
Kern Hills Petroleum Corp., Ltd.-----	6	28	29	1	Round Mountain
Shell Oil Co.-----	29	28	29	Jewett 7	Round Mountain
Shell Oil Co.-----	29	28	29	Jewett 8	Round Mountain
Sunnyside Oil Co., Ltd.-----	17	28	29	Smith 1	Round Mountain
Birch-Royer-----	7	11	23	2	Sunset
California Western Oil Co.-----	17	11	23	Havenstrite 2	Sunset
California Western Oil Co.-----	17	11	23	Havenstrite 4	Sunset
Doyle Petroleum Corp.-----	8	11	23	Berta Wier 2	Sunset
Doyle Petroleum Corp.-----	8	11	23	Son-Crail 1	Sunset
Hancock Oil Co.-----	8	11	23	Maricopa 2	Sunset
North American Oil Cons.-----	8	11	23	Kerckhoff 1	Sunset
North American Oil Cons.-----	8	11	23	Sunset 2	Sunset
North American Oil Cons.-----	8	11	23	Sunset 4	Sunset
Reservoir Hill Gasoline Co.-----	17	11	23	1	Sunset
Reservoir Hill Gasoline Co.-----	17	11	23	Havenstrite 2	Sunset
Signal Oil & Gas Co.-----	8	11	23	Sheehan 5	Sunset
Signal Oil & Gas Co.-----	8	11	23	Signal Wallace 4	Sunset
Standard Oil Co.-----	7	11	23	Graham 2	Sunset
Standard Oil Co.-----	9	11	23	7	Sunset
Union Oil Co.-----	8	11	23	Son 1	Sunset
Wellington Oil Co.-----	8	11	23	Wellington-Maricopa 1	Sunset
E. L. Blanck-----	20	32	23	1	-----
The Eastern Sunset Oil, Ltd.-----	6	11	22	Reardon 1	-----
Gus Ninkovich-----	9	30	21	1	-----
General Petroleum Corp.-----	13	29	26	K. C. L. 13 1	-----
Fred M. Sayre-----	8	26	28	1	-----
Shell Oil Co.-----	20	26	28	Buchner 1	-----
Shell Oil Co.-----	31	28	27	Core Hole F	-----
Shell Oil Co.-----	1	29	26	Core Hole G	-----
The Texas Co.-----	23	29	28	Newman 1	-----
Union Oil Co.-----	8	11	24	N. & F. 1	-----
Wesco Petroleum Co.-----	14	11	24	1	-----
<b>KINGS COUNTY:</b>					
George F. Getty, Inc.-----	20	23	19	Erwin 1	Kettleman Hills
Standard Oil Co.-----	7	22	18	21	Kettleman Hills
J. E. O'Donnell-----	7	23	20	Dudley Ridge 2	-----
Hugh B. Porter-----	9	24	17	1	-----
<b>LOS ANGELES COUNTY:</b>					
Shell Oil Co.-----	34	3	13	Childs 3	Dominguez
Shell Oil Co.-----	34	3	13	Reyes 39	Dominguez
Standard Oil Co.-----	7	2	14	Vickers 1 22	Inglewood
Standard Oil Co.-----	8	2	14	Vickers 1 23	Inglewood
Para-Cal Oil Corp.-----	16	3	14	Para-Cal 1	Lawndale
Aitken Oil Co.-----	24	4	13	3	Long Beach
Bar How Oil Co.-----	13	4	13	1	Long Beach
Bixby, Adams & McFadden-----	29	4	12	B. A. M. 2	Long Beach
Bush-Voorhis Oil Co.-----	19	4	12	11-A	Long Beach
J. H. Cochran-----	19	4	12	Cochran 5	Long Beach
Congress Petroleum Corp.-----	19	4	12	Butler-Holcombe 1	Long Beach
Continental Oil Co.-----	19	4	12	Modoc 2	Long Beach
Dabney-Johnston Oil Corp.-----	19	4	12	45	Long Beach
Dabney-Johnston Oil Corp.-----	24	4	13	41	Long Beach
Dabney-Johnston Oil Corp.-----	24	4	13	42	Long Beach
Dabney-Johnston Oil Corp.-----	24	4	13	44	Long Beach
K. S. Deeds Oil Co., Inc.-----	29	4	12	5	Long Beach
Delaney Petroleum Corp.-----	19	4	12	Wellington 4	Long Beach

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
<b>LOS ANGELES COUNTY—Continued.</b>					
Dell Oil Syn.....	19	4	12	Keaton 3	Long Beach
Denny Drilling Co., Ltd.....	24	4	13	1	Long Beach
Hancock Oil Co.....	13	4	13	Signal 21	Long Beach
Hancock Oil Co.....	24	4	13	Signal 20	Long Beach
Otis Hoyt.....	29	4	12	8	Long Beach
Otis Hoyt.....	24	4	13	9	Long Beach
A. T. Jergins Syn., Inc.....	13	4	13	7	Long Beach
A. T. Jergins Syn., Inc.....	13	4	13	9	Long Beach
A. T. Jergins Syn., Inc.....	24	4	13	8	Long Beach
A. N. Macrate.....	19	4	12	Mackay 2	Long Beach
A. N. Macrate.....	19	4	12	Mackay 3	Long Beach
W. F. Meyer.....	24	4	13	5	Long Beach
Pan American Petroleum Co.....	19	4	12	Chainey 5	Long Beach
Petroleum Securities Co.....	19	4	12	Young 2	Long Beach
Petroleum Securities Co.....	19	4	12	Young 3	Long Beach
Petroleum Securities Co.....	19	4	12	Wallow 1	Long Beach
Petroleum Securities Co.....	29	4	12	Graham 1	Long Beach
Max Pray.....	24	4	13	4	Long Beach
Richfield Oil Co.....	19	4	12	Bernstein 5	Long Beach
Richfield Oil Co.....	24	4	13	Duncan 5	Long Beach
Roggie-Johnson Drilling Co.....	19	4	12	1	Long Beach
Sovereign Oil Corp.....	24	4	13	7	Long Beach
The Texas Co.....	13	4	13	Fee 1	Long Beach
Woolner Oil Corp.....	13	4	13	L. B. Fee 1	Long Beach
St. Helens-Riverside Properties.....	3	2	12	Monterey 18	Montebello
C. S. Blinn.....	28	2	14	1	Potrero
C. S. Blinn.....	28	2	14	2	Potrero
George F. Getty, Inc.....	28	2	14	P-1	Potrero
E. K. Allison Syn.....	6	3	11	1	Santa Fe Springs
Associated Oil Co.....	31	2	11	Dallugge 8	Santa Fe Springs
Associated Oil Co.....	31	2	11	Dallugge 9	Santa Fe Springs
Associated Oil Co.....	6	3	11	Dewenter 9	Santa Fe Springs
Associated Oil Co.....	1	3	12	Clarke 22	Santa Fe Springs
H. A. Bardeen.....	6	3	11	Santa Fe 4	Santa Fe Springs
The Elmer Co.....	6	3	11	Jameson 3	Santa Fe Springs
The Elmer Co.....	6	3	11	Jameson 5	Santa Fe Springs
Ethyl Oil Co.....	5	3	11	8	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 137-E	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 143-B	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 146-B	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 223	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 239	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Jalk 115	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe 190-E	Santa Fe Springs
General Petroleum Corp.....	6	3	11	Santa Fe	Santa Fe Springs
George F. Getty, Inc.....	5	3	11	Comm. 177-F	Santa Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 44	Santa Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 40	Santa Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 41	Santa Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 42	Santa Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 43	Santa Fe Springs
George F. Getty, Inc.....	6	3	11	S. F. S. 45	Santa Fe Springs
Lockhart & York.....	6	3	11	3	Santa Fe Springs
Ort & Ferrell, Inc.....	6	3	11	1	Santa Fe Springs
Richfield Oil Co.....	5	3	11	Mayberry 1	Santa Fe Springs
Richfield Oil Co.....	6	3	11	Wardman 2	Santa Fe Springs
Second Twin Bell Syn.....	6	3	11	7	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 25	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 26	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 27	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 28	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 29	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 30	Santa Fe Springs
Shell Oil Co.....	31	2	11	G. H. N. 31	Santa Fe Springs
Shell Oil Co.....	6	3	11	Slusher B-3	Santa Fe Springs
Shell Oil Co.....	6	3	11	Slusher B-3-A	Santa Fe Springs
Shell Oil Co.....	6	3	11	Slusher 20	Santa Fe Springs
Shell Oil Co.....	6	3	11	Slusher 22	Santa Fe Springs



## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Weil No.	Field
LOS ANGELES COUNTY—Continued.					
Shell Oil Co.-----	6	3	11	Slusher 23	Santa Fe Springs
Shell Oil Co.-----	6	3	11	Slusher 24	Santa Fe Springs
Shell Oil Co.-----	6	3	11	Slusher 26	Santa Fe Springs
Shell Oil Co.-----	6	3	11	Slusher 27	Santa Fe Springs
The St. Helens Petroleum Co., Ltd....	6	3	11	Hill 2	Santa Fe Springs
Standard Oil Co.-----	31	2	11	Santa Gertrudes 11-A	Santa Fe Springs
Standard Oil Co.-----	31	2	11	Santa Gertrudes 13	Santa Fe Springs
Standard Oil Co.-----	5	3	11	South Whittier Comm. 22	Santa Fe Springs
Standard Oil Co.-----	5	3	11	South Whittier Comm. 29	Santa Fe Springs
Standard Oil Co.-----	6	3	11	Johnson 7	Santa Fe Springs
Standard Oil Co.-----	6	3	11	Koontz 12	Santa Fe Springs
Standard Oil Co.-----	6	3	11	S.G. & J. Line 2	Santa Fe Springs
Standard Oil Co.-----	6	3	11	Walker Comm. 21	Santa Fe Springs
Standard Oil Co.-----	6	3	11	Walker Comm. 22	Santa Fe Springs
Standard Oil Co.-----	1	3	12	Standard- Wardman 1	Santa Fe Springs
The Texas Co.-----	31	2	11	Matern Two 13	Santa Fe Springs
The Texas Co.-----	6	3	11	Baldwin 5	Santa Fe Springs
The Texas Co.-----	6	3	11	Batson 6	Santa Fe Springs
The Texas Co.-----	6	3	11	Foix 7	Santa Fe Springs
The Texas Co.-----	6	3	11	Foix 8	Santa Fe Springs
The Texas Co.-----	6	3	11	Matern Two 11	Santa Fe Springs
The Texas Co.-----	6	3	11	Matern Two 12	Santa Fe Springs
The Texas Co.-----	6	3	11	Standlee 6	Santa Fe Springs
The Texas Co.-----	6	3	11	Weaver 9	Santa Fe Springs
Third Twin Bell Syn.-----	6	3	11	Callahan 1	Santa Fe Springs
Union Oil Co.-----	6	3	11	Alexander 20	Santa Fe Springs
Union Oil Co.-----	6	3	11	Alexander 21	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 52	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 53	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 54	Santa Fe Springs
Union Oil Co.-----	6	3	11	Bell 55	Santa Fe Springs
Universal Consolidated Oil Co.-----	5	3	11	O'Connell 6	Santa Fe Springs
Universal Consolidated Oil Co.-----	6	3	11	Blanchard 12	Santa Fe Springs
Universal Consolidated Oil Co.-----	6	3	11	Blanchard 13	Santa Fe Springs
Wilshire Annex Oil Co.-----	6	3	11	Wilshire Annex Koontz 5-A	Santa Fe Springs
Wilshire Oil Co., Inc.-----	6	3	11	Wilshire- Buckbee 2	Santa Fe Springs
Wilshire Oil Co. Inc.-----	6	3	11	Wilshire- Cecelia 2	Santa Fe Springs
Wilshire Oil Co., Inc.-----	6	3	11	Wilshire- Crawford 2	Santa Fe Springs
Fred R. Hudson-----	3	5	12	1	Seal Beach
Marland Oil Co.-----	2	5	12	Bixby 30	Seal Beach
Marland Oil Co.-----	11	5	12	Bixby 31	Seal Beach
Standard Oil Co.-----	11	5	12	San Gabriel 24	Seal Beach
Nelson J. Hansen-----	17	4	13	Watson 1	-----
The Ohio Oil Co.-----	21	2	15	Recreation Gun Club 1	-----
The State Co.-----	5	2	10	Richfield- Puente 1	-----
L. Morgan West-----	16	1	11	Sing 1	-----
MONTEREY COUNTY:					
H. B. Chessher-----	8	23	9	1	-----
Standard Oil Co.-----	23	22	7	Piedmont 1	-----
ORANGE COUNTY:					
Camp Oil Co., Inc.-----	1	6	11	1	Huntington Beach
Rex Oil Co.-----	2	6	11	14	Huntington Beach
Richfield Oil Co.-----	35	5	11	Paige 1	Huntington Beach

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued					
Richfield Oil Co.-----	2	6	11	Dieter-Golay 1	Huntington Beach
Standard Oil Co.-----	2	6	11	Huntington	
				B 63	Huntington Beach
Standard Oil Co.-----	12	6	11	Thomson 10	Huntington Beach
V. R. G. Wilbur-----	2	6	11	Twinning 1	Huntington Beach
Arrowhead Oil Co.-----	33	3	9	Zuckerman 1	Richfield
Continental Oil Co.-----	33	3	9	Lypps 1	Richfield
Continental Oil Co.-----	33	3	9	Ross-	
				Schlachter 1	Richfield
Continental Oil Co.-----	33	3	9	Winann 3	Richfield
Howard, Hathaway & Boroughs-----	33	3	9	1	Richfield
Superior Oil Co.-----	33	3	9	Guarantee 3	Richfield
Union Oil Co.-----	29	3	9	Chapman 28	Richfield
Union Oil Co.-----	29	3	9	Morse 9	Richfield
Superior Oil Co.-----	33	3	9	Schroeder 1	-----
RIVERSIDE COUNTY:					
Fidelity Realty Corp.-----	23	7	3	Watt 2	-----
SAN BERNARDINO COUNTY:					
China-American Oil Co.-----	18	4	4	1	-----
SAN LUIS OBISPO COUNTY:					
Dollar Oil Co.-----	24	32	22	Jones 1	-----
SANTA BARBARA COUNTY:					
Bankline Oil Co.-----	15	4	29	1	Elwood
Barnsdall Oil Co.-----	15	4	29	Luton-Bell 8	Elwood
Barnsdall Oil Co.-----	15	4	29	Tideland	
				Permit 88 1	Elwood
Barnsdall Oil Co.-----	22	4	29	Tideland	
				Permit 94 1	Elwood
Elwood Exploration Co.-----	22	4	29	Elwood 1	Elwood
C. J. Mahoney-----	22	4	29	Mahoney 1	Elwood
Caroline C. Spalding-----	16	4	29	1	Elwood
L. B. Tannehill-----	24	4	29	Tannehill 1	Elwood
Barnsdall Oil Co.-----	1	4	30	Edwards Joint 1	Goleta
Associated Oil Co.-----	21	4	26	S. P. Summer-	
				land 1	Summerland
George F. Getty-----	21	4	26	State Lease No.	
				16 Getty 1	Summerland
George F. Getty, Inc.-----	21	4	26	Becker Fee 1	Summerland
George F. Getty, Inc.-----	21	4	26	Becker Fee 2	Summerland
George F. Getty, Inc.-----	21	4	26	Becker Fee 3	Summerland
Lincoln Drilling Co.-----	21	4	26	2-A	Summerland
Lincoln Drilling Co.-----	21	4	26	3-A	Summerland
B. C. Morrison-----	22	4	26	1	Summerland
Sandoma Gasoline Co.-----	22	4	26	State Lease No.	
				18 Sandoma 1	Summerland
Southern Exploration Co.-----	16	4	26	Brooks 1	Summerland
Southern Exploration Co.-----	21	4	26	1	Summerland
Southern Exploration Co.-----	21	4	26	2	Summerland
Bolsa Chica Oil Corp.-----	29	4	27	Filmore 1	-----
California Properties, Inc.-----	3	4	28	1	-----
Carrey & Adams-----	1	4	28	Wright 1	-----
Gaviota Oil Co. of Delaware, Ltd.-----	29	4	27	1	-----
Gaviota Oil Co. of Delaware, Ltd.-----	7	35	1	-----	-----
General Petroleum Corp.-----	5	4	30	Erburo 1	-----
Gilmore Oil Co.-----	1	5	28	1	-----
Lincoln Drilling Co.-----	30	4	27	1	-----
Olympic Refining Co.-----	4	4	27	Mesa 1	-----
Shell Oil Co.-----	24	10	35	Union-	
				Sugar A-6	-----
Standard Oil Co.-----	35	6	36	Sudden 1	-----
Western Gulf Oil Co.-----	5	33	Hollister 2	-----	-----
STANISLAUS COUNTY:					
C. E. Barnhart Oil Trust-----	3	2	10	1	-----

## OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
TULARE COUNTY:					
A. Bruce Frame.....	8	23	26	1	
Vedder Brothers, Inc.....	22	24	27	Hart 1	
VENTURA COUNTY:					
C. C. M. O. Co.....	17	3	24	Hobson B 8	Rincon
C. C. M. O. Co.....	23	3	24	Hobson A 2	Rincon
General Petroleum Corp.....	7	3	24	Ferguson 1	Rincon
General Petroleum Corp.....	8	3	24	Tomson 5	Rincon
Associated Oil Co.....	23	3	23	Lloyd 125	Ventura
Associated Oil Co.....	23	3	23	McGonigle 3-A	Ventura
Associated Oil Co.....	23	3	23	V. L. & W. 11	Ventura
Associated Oil Co.....	26	3	23	Lloyd 97	Ventura
Shell Oil Co.....	28	3	23	Edison 26	Ventura
Shell Oil Co.....	28	3	23	Taylor 46	Ventura
Shell Oil Co.....	28	3	23	Taylor 47	Ventura
Shell Oil Co.....	28	3	23	Taylor 49	Ventura
Shell Oil Co.....	28	3	23	Taylor 51	Ventura
Shell Oil Co.....	29	3	23	Taylor 11	Ventura
Shell Oil Co.....	29	3	23	Taylor 45	Ventura
Shell Oil Co.....	29	3	23	Taylor 48	Ventura





## ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

**John Hays Hammond Public Mining Library.**

About 1911, Mr. John Hays Hammond donated a fund of \$5,000 for the purchase of books on mining, geology, and metallurgy. It was placed in the hands of Mr. Charles G. Yale, as trustee (since deceased), then and for many years in charge of the San Francisco office of the United States Geological Survey and for a time statistician of the State Mining Bureau. The 'John Hays Hammond Public Mining Library' was created and has since been maintained as a distinct unit housed in the main library of the State Mining Bureau (now Division of Mines) in the Ferry Building, San Francisco.

A few weeks ago, advice from the local bank where the fund had been deposited informed us that there was available a balance of several hundred dollars. Correspondence with Mr. Hammond resulted in naming the present state mineralogist as trustee, and we have recently added some 120 volumes of new books to the Hammond section. These up-to-date books are especially appreciated at this time, as the main library of the Division of Mines is not able to add (except through exchanges with other surveys) more than an occasional volume by purchase, for lack of available funds.

**Personnel.**

There have been no changes of personnel to be noted during the past three months.

**New Publications.**

During the quarterly period covered by this issue, the following publications of the Division have been made available for distribution:

**Mining in California** (quarterly). April and July, 1929, being chapters 2 and 3 of State Mineralogist's Report XXV. Price 25 cents each. The April issue contains reports on the Mineral Resources of Napa, San Francisco, San Mateo, and Sierra counties. The July issue contains reports on the Mineral Resources of Colusa, Fresno, and Lake counties; also the following special articles: "Ore-Buyers' License Act"; "Assessment Work on Mining Claims within Withdrawn Areas"; "Surface Rights of a Mineral Locator within the National Forests"; "'Mine' and 'Mineral' defined for Mining Bureau Act"; "'Division of Mines' Amendment."

**Summary of Operations, California Oil Fields**, Vol. 14, Nos. 5 and 6, November and December, 1928, respectively, containing the following special articles: (November), Preliminary Report on the Kettleman Hills Oil Field"; (December), "Measurement of Gas Production."

**Mails and Files.**

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered

daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.



## MINERALS AND STATISTICS

## Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

## STATISTICS

Data on the 1928 production of some of California's minerals were given in both the April and July issues of *Mining in California* and tabulations are presented herein showing the completed totals for all substances for the year, grouped by substances and by counties. The complete annual report on mineral production of California for 1928 is now in press as Bulletin No. 102 of the State Division of Mines.

## Summary for 1928.

The total value of the mineral output of California for 1928 was \$332,714,233, being a decrease of \$34,067,161 from the 1927 total of \$366,781,394. There were fifty-four different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1928 compared with the preceding year are: A large drop in the value of the petroleum yield, also material decreases in the value of brick and hollow building tile, cement, gold, granite, and miscellaneous stone; which were partly offset by marked increases in both quantity and value of the following: borates, clay (pottery), fuller's earth, natural gas, quicksilver, potash and salt. Petroleum showed a decrease in value of \$30,736,818, although there was an increase in amount from 231,195,774 barrels to 231,811,465 barrels. This was due to the low price of crude oils which prevailed throughout the year; while natural gas increased from 224,686,940 M cu. ft. worth \$20,447,294 to 260,887,116 M cu. ft. worth \$22,260,947. The net results were increases in the industrial and saline group while all other groups showed a decline.

Of the metals, a production of tin was reported, the first time since 1892; quicksilver increased from 6488 (75-pound) flasks worth \$714,418 to 7107 (76-pound) flasks worth \$844,649, this being accounted for by the increased price received by the producers; in 1927 they received \$111.67 per 75-pound flask and in 1928 \$118.88 per 76-pound flask. Copper, although there was a decrease in the amount there was a slight increase in value as shown, 27,350,316 pounds worth \$3,582,885 to 25,162,304 pounds worth \$3,623,360; gold decreased from \$11,671,018 to \$10,785,315; lead from 2,748,440 pounds worth \$173,151 to 1,882,795 pounds worth \$109,102; silver from 1,620,242 fine oz. worth \$918,677 to 1,478,771 fine oz. worth \$865,081; and there was no reported production of zinc. In 1927 there were extremely low market prices in base metals which forced several producers of copper, lead and zinc to suspend operations and the revival of the market in 1928 only favorably affected the price of copper; while the gold and silver, by-products in these ores, account for the decreases in the total gold and silver figures. Though the gold yield decreased in value, California continues to account for approximately 30 per cent of the gold output of the United States.



Of the structural group, there was a general decrease in the amount and value owing to a decline in building in the cities. Brick and hollow building tile decreased from a value of \$6,516,077 to \$5,694,770; cement from 14,661,783 bbls. worth \$26,474,935 to 13,625,231 bbls. worth \$24,463,287; granite from a value of \$1,398,443 to \$763,996; and miscellaneous stone from a value of \$18,912,994 to \$17,332,110; of the remaining minerals in this group all showed a slight decline in amount and value with the exception of chromite and slate, both of which showed increases.

Of the industrial group there were a number of fluctuations with a general trend of increased productions and values. The important changes were: clay (pottery) with an increase from 867,419 tons worth \$872,661 to 887,807 tons worth \$1,394,950; fuller's earth from 13,018 tons worth \$154,764 to 53,323 tons worth \$501,743.

Of the saline group there was a general increased production and value with the exception of bromine and magnesium salts, both of which showed slight decreases; potash showed the greatest increase but the amount is concealed owing to a single producer; borates increased from 72,462 tons worth \$3,034,260 to 109,722 tons worth \$3,378,552; salt from 263,028 tons worth \$639,127 to 340,480 tons worth \$1,024,656.

#### MINERAL PRODUCTION BY SUBSTANCES FOR 1928

<i>Mineral</i>	<i>Amount</i>	<i>Value</i>
Antimony-----	70 tons	\$761
Barites-----	13,406 tons	55,888
Bituminous rock-----	4,966 tons	33,832
Borates-----	109,722 tons	3,378,552
Brick and hollow building tile-----		5,694,770
Cement-----	13,625,231 bbls.	24,463,287
Chromite-----	729 tons	15,179
Clay (pottery)-----	887,807 tons	1,394,950
Coal-----	582 tons	3,442
Copper-----	25,162,304 lbs.	3,623,260
Dolomite-----	38,379 tons	85,342
Feldspar-----	14,628 tons	93,745
Fuller's earth-----	53,323 tons	501,743
Gems-----		22,200
Gold-----		10,785,315
Granite-----		763,996
Gypsum-----	104,790 tons	200,567
Lead-----	1,882,795 lbs.	109,102
Lime-----	56,616 tons	547,919
Limestone-----	127,895 tons	397,935
Magnesite-----	45,645 tons	501,590
Marble, onyx and travertine-----	34,324 cu. ft.	82,190
Mineral water-----	25,049,002 gals.	1,304,969
Natural gas-----	260,887,116 M cu. ft.	22,260,947
Petroleum-----	231,811,465 bbls.	229,998,680
Platinum-----	312 fine oz.	27,902
Pumice and volcanic ash-----	10,440 tons	105,055
Pyrite-----	90,566 tons	400,627
Quicksilver-----	7,107 flasks	844,649
Salt-----	340,480 tons	1,024,656
Sandstone-----	134,100 cu. ft.	43,250
Silica-----	14,814 tons	66,679
Silver-----	1,478,771 fine oz.	865,081
Slate-----	4,075 tons	31,263
Soapstone and talc-----	18,668 tons	251,372
Soda-----	80,838 tons	1,469,297
Stone, miscellaneous <sup>a</sup> -----		17,332,110
Unapportioned <sup>b</sup> -----		3,932,031
Total value-----		\$332,714,233

<sup>a</sup> Includes macadam, ballast, rubble, riprap, sand, gravel, and grinding mill pebbles.

<sup>b</sup> Includes asbestos, bromine, calcium chloride, diatomaceous earth, lithia, magnesium salts, manganese ore, mineral paint, potash, sillimanite-andalusite-cyanite group, tin, titanium and tungsten.

Distribution by counties is given in the following tabulation:

Alameda	\$2,421,830	Placer	\$333,135
Alpine	8,529	Plumas	3,599,127
Calaveras	2,644,179	Riverside	6,274,901
Colusa	640,272	Sacramento	2,389,645
Contra Costa	2,802,542	San Benito	1,654,718
Del Norte	36,500	San Bernardino	14,157,381
El Dorado	2,100,482	San Diego	1,770,253
Esmeraldo	381,358	San Francisco	67,430
Fresno	329,427	San Joaquin	624,931
Glenn	4,227,286	San Luis Obispo	217,125
Humboldt	101,889	San Mateo	3,328,573
Imperial	300,227	Santa Barbara	4,577,650
Inyo	241,678	Santa Clara	1,021,541
Kern	1,832,567	Santa Cruz	3,323,920
Kings	43,064,781	Shasta	1,114,729
Lake	577,819	Sierra	679,925
Lassen	189,103	Siskiyou	471,166
Los Angeles	76,499	Solano	57,451
Madera	144,835,988	Sonoma	212,568
Marin	514,495	Stanislaus	472,158
Mariposa	449,568	Sutter	2,000
Merced	282,201	Tehama	14,389
Modoc	40,490	Trinity	530,180
Monterey	653,187	Tulare	445,366
Napa	30,440	Tuolumne	376,278
Nevada	214,420	Ventura	31,116,675
Orange	351,660	Yolo	17,200
	306,262	Yuba	2,529,076
	2,023,886		
	39,355,177	Total	\$332,714,233

## MUSEUM

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the State and to San Francisco.

## LABORATORY

FRANK SANBORN, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this state department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The Division is often able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Very small pieces of certain silicates, such as andalusite, have been supplied to those desiring them.

Several thousand determinations are made annually by the Division of Mines, and prospecting and exploitation of the state's mineral wealth increases as the state becomes more thickly populated. Each year new occurrences of some mineral in the state are reported and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.





## LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, MINING IN CALIFORNIA contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

## OFFICIAL PUBLICATIONS RECEIVED

## Governmental.

## U. S. Geological Survey:

## Professional Papers:

- 154-A—Moraines and Shore Lines of the Lake Superior Region. By F. Leverett.
- 158-A—The Occurrence and Origin of Analcite and Meerschaum Beds in the Green River Formation of Utah, Colorado and Wyoming. By W. H. Bradley.
- 158-B—The Contact of the Fox Hills and Lance Formations. By C. E. Dobbin and J. B. Reeside, Jr.

## Bulletins:

- 797 —Mineral Resources of Alaska, in 1926. By P. S. Smith and others.
- 799 —Geology of the McCalls Ferry-Quarryville District, Pennsylvania. By E. B. Knopf and A. I. Jonas.
- 800 —Geology and Mineral Deposits of Southeastern Alaska. By A. F. Buddington and T. Chapin.
- 804 —Geology and Coal and Oil Resources of the Hanna and Carbon Basins, Carbon County, Wyoming. By C. E. Dobbin, C. F. Bowen and H. W. Hoots.
- 806 —Contributions to Economic Geology, 1928.
- 808 —Geology of the DeQueen and Caddo Gap Quadrangles, Arkansas. By H. D. Miser and A. H. Purdue.
- 809 —Formulas and Tables for the Construction of Polyconic Projections. By C. H. Birdseye.
- 810-C—The Mount Spurr Region, Alaska. By S. R. Capps.

811-B—Recent Mining Developments in the Creede District, Colorado. By E. S. Larsen.

812-A—The Forsyth Coal Field, Montana. By C. E. Dobbin.

#### Water Supply Papers:

597-C—Problems of the Soft-Water Supply of the Dakota Sandstone. By O. E. Meinzer.

597-E—Surface Water Supply of the Sacramento River Basin, California, 1895-1927. By H. D. McGlashan.

599 —Ground Water in Yellowstone and Treasure Counties, Montana. By G. M. Hall and C. S. Howard.

600 —Geology and Ground-Water Resources of Central and Southern Rosebud County, Montana. By B. C. Renick and H. B. Rifenburg.

611 —Surface Water Supply of the United States, 1925.

612 —Surface Water Supply of the United States, 1925.

#### Hawaiian Volcano Observatory:

Vol. 16, Nos. 6, 7, 8 and 9.

#### U. S. Bureau of Mines:

##### Technical Papers:

296 —Size and Character of Grains of Nonmetallic Mineral Fillers. By W. M. Weigel.

454 —Permissible Junction Boxes. By L. C. Ilsley and R. A. Kearns.

##### Bulletins:

300 —Coal-Washing Investigations.

303 —Tests of Strength of Roof Supports Used in Anthracite Mines of Pennsylvania.

308 —Oxides in Pig Iron: Their Origin and Action in the Steel-Making Process.

##### Mineral Resources:

Gold, Silver, Copper, Lead and Zinc in Colorado in 1927. By C. W. Henderson.

Fluorspar and Cryolite in 1928. By H. W. Davis.

Fuller's Earth in 1928. By J. Middleton.

Gold, Silver, Copper, Lead and Zinc in Idaho and Washington in 1927. By C. N. Gerry.

Coke and By-Products in 1927. By F. G. Tryon and H. L. Bennit.

Gold, Silver, Copper, Lead and Zinc in Nevada in 1927. By C. N. Gerry.

Gold and Silver in 1927. By J. P. Dunlop.

Gold, Silver, Copper, Lead and Zinc in Utah in 1927. By C. N. Gerry.

Copper in 1927. By C. E. Julihn and H. M. Meyer.

Gold, Silver, Copper, Lead and Zinc in Arizona in 1927. By C. N. Gerry.

Carbon Black in 1928. By G. R. Hopkins and H. Backus.

Mineral Resources of the United States in 1928.

##### Reports of Investigations:

2947—Active List of Permissible Explosives and Blasting Devices Approved Prior to June 30, 1929.

2948—Crushing Resistance of Minerals. By S. R. Zimmerley and John Gross.

(Gives results of tests to determine crushing resistance of quartz, pyrite, sphalerite, calcite, and galena.)

2949—The Relation of Table Feed Preparation to Table Efficiency. By A. W. Fahrenwald and W. F. Meckel.

(Outlines results of tests made with quartz, silica, galena, magnetite beach sand, and siderite to determine relationship of specific gravity, size and shape of sand grains comprising table feeds to table efficiency.)

2950—The Role of Stratification in the Separation of Coal and Refuse on a Coal-Washing Table. By B. M. Bird and H. S. Davis.

2951—A Method for the Sizing of Ore by Elutriation. By John Gross, S. R. Zimmerley and Alan Probert.

- (Describes new method of elutriation for sizing the material finer than 200 mesh, to determine metallurgical recovery and for determination of surface in calculation of grinding efficiency.)
- 2952—Efficiency of Grinding Mills. By John Gross and S. R. Zimmerley. (Gives results of tests made with galena, sphalerite and pyrite to develop a method whereby surface figures are obtained on a ground ore by comparison with determined values for quartz and by application of correction factors for density and for irregularity of particles.)
- 2953—Official Changes in the Active List of Permissible Explosives and Blasting Devices for August, 1929. (Supplements complete list published as Serial 2947, July, 1929.)
- 2954—Smelting in the Lead Blast Furnace. I. A Method for Approximating the Form of the Lead in Slag and Other Products of the Lead Blast Furnace. By G. L. Oldright and Virgil Miller.
- 2955—Some Important Factors in Sponge Iron Production. By Edward P. Barrett. (Discusses progression of sponge iron to steel, reduction of iron oxides, elimination of gangue, and absorption of sulphur.)
- 2956—Review of Fatalities in the California Petroleum Industry During the Calendar Year 1928. By G. B. Shea. (Summarizes fatalities in drilling and producing operations, pipe line and transportation operations, at natural gasoline plants, and in sales and marketing activities. Outlines causes of accidents and presents safety recommendations.)
- 2957—Smelting in the Lead Blast Furnace. II. The Gases from the Top of the Lead Blast Furnace. By G. L. Oldright and Virgil Miller. (The second paper of the series on smelting in the lead blast furnace referred to under 2954.)
- 2958—Official Changes in the Active List of Permissible Explosives and Blasting Devices for September, 1929.
- 2959—Twentieth Semi-Annual Motor Gasoline Survey. By E. C. Lane, S. S. Taylor and C. J. Wilhelm. (Contains results of survey of motor gasoline marketed in various cities, and gives data regarding characteristics of such gasolines.)

#### Information Circulars:

- 6143—Safeguarding Electrical Equipment Used in Gassy Mines, European Practice: III—Germany. By L. C. Ilsley. (Gives results of observations made by author in the course of a tour of personal inspection. Quotes freely from pioneer work of Dr. Beyling relating to electrical motors used in gassy mines. Comments on German regulations covering electrical mining equipment.)
- 6150—Mining Methods and Costs in the Waco District. By Leon M. Banks.
- 6151—Method and Cost of Mining the Upper and Lower Freeports and the Lower Kittanning Coal in a Group of Mines in Western Central Pennsylvania. By J. W. Paul and H. Tomlinson.
- 6152—Method and Cost of Mining the Thick Freeport Coal in a Second Western Pennsylvania Mine. By J. W. Paul and H. Tomlinson.
- 6153—Safety in Mines as Affected by First-Aid and Mine-Rescue Contests. By W. D. Ryan.
- 6154—Geophysical Abstracts No. III. By F. W. Lee.
- 6155—Clay. By P. M. Tyler.
- 6156—Special Features of Core Drilling in the Salt Beds of Western Texas and New Mexico. By James S. Wroth.
- 6157—Marketing of Gypsum Products. By R. M. Santmyers. (Presents statistical data regarding sales of crude gypsum and gypsum building materials and other gypsum products; analyzes market conditions by geographical districts.)
- 6158—Explosions and Other Accidents from Mucapped Shots in Coal Mines. By D. Harrington and C. W. Owings.



- 6159—Method and Cost of Mining at Barr Mine, Tri-State Zinc and Lead District. By Oliver W. Keener.  
(Another issue in the series of papers describing mining methods and costs at representative mines in the different districts.)
- 6160—Method and Cost of Mining at No. 8 Mine, St. Louis Smelting and Refining Company, Southeast Missouri District. By R. H. Poston.
- 6161—Signaling from Cages at Rest or in Motion. By D. J. Parker and R. I. C. Manning.
- 6162—The Canadian Gypsum Industry. By R. M. Santmyers.
- 6164—Geophysical Abstracts. No. 4. By F. W. Lee.
- 6165—Consumption of Tin in the United States During 1928. By J. B. Umhau.
- 6166—Accident Cost and Mine Safety. By E. H. Denny.  
(Contains statistical information relative to industrial losses due to mine accidents, and summarizes Bureau of Mines recommendations as to the lessening of accidents in the mining industry.)
- 6167—Mining Practice at Ray Mines, Nevada Consolidated Copper Co., Ray, Arizona. By Robert W. Thomas.
- 6168—Mining Methods and Costs at the Magma Mine, Superior, Ariz. By Fred W. Snow.
- 6169—Mining Practice and Methods at Inspiration Consolidated Copper Co., Inspiration, Ariz. By Alfred C. Stoddard.
- 6170—Methods of Mining Disseminated Lead Ore at a Mine in the Southeast Missouri District. By C. F. Jackson.
- 6172—List of Permissible Mining Equipment.
- 6174—Method and Cost of Mining Zinc and Lead at No. 3 Mine, Tri-State District, Crestline, Kan. By Wm. F. Netzeband.
- 6175—Geophysical Abstracts No. V. By F. W. Lee.
- 6187—Sources and Distribution of Major Petroleum Products, Atlantic Coast States, 1928. By E. B. Swanson.

#### Miners' Circulars:

- 36—Advanced Mine Rescue Training. By J. J. Forbes and G. W. Grove.

#### Petroleum Field Office:

- Recent Articles on Petroleum and Allied Substances: June, July and August, 1929.
- Statistical Summary of the California Petroleum Industry, 1928. By E. T. Knudsen.

#### U. S. Bureau of Foreign and Domestic Commerce:

##### Monthly Summary of Foreign Commerce of the U. S.:

- Part 2, May, 1929.
- Part 2, June, 1929.
- Part 1, July, 1929.
- Part 2, July, 1929.
- Part 1, August, 1929.
- Part 2, August, 1929.

#### Trade Promotion Series:

- 76—Mineral Raw Materials.

#### Trade Information Bulletins:

- 359—Iron and Alloy Metals in Siberia.
- 367—French Iron and Steel Industry.
- 385—Foreign Combinations to Control Prices of Raw Materials.
- 407—British Petroleum Trade in 1925.
- 442—Asbestos Sources and Trade.
- 455—Portugal.
- 457—The Bombay Bullion Market.
- 470—Iron and Steel Trade and Industry of the Netherlands.
- 480—The German Jewelry Industry.
- 484—Origin and Development of the Continental Steel Entente.
- 489—Coal in Europe.
- 577—The Italian Chemical Industry.

- 599—The Marketing of Manganese Ore.
- 601—Ceylon.
- 605—German Chemical Developments in 1928.
- 612—The Production of Iron and Steel in Japan.
- 621—British Chemical Trade in 1928.
- 622—Fuel and Power in Canada.
- 623—Petroleum Refineries in Foreign Countries, 1929.
- 624—The Marketing of Antimony.
- 626—Free and Dutiable Imports of the United States, 1927.
- 631—The Marketing of Mercury.

Alabama Geological Survey:

Bulletins:

- 33—Lignite in Alabama. By J. Barksdale.
- 35—Molding Sands of Alabama. By G. I. Adams.
- 36—Statistics of the Mineral Production of Alabama for 1926. By J. Barksdale.

Special Report:

- 15—Oil and Gas in Alabama. By R. D. Semmes.

Arkansas Geological Survey:

- Upper Cretaceous Formations of Southwestern Arkansas. By C. H. Dane.

California State Division of Engineering and Irrigation:

Bulletins:

- 3—Water Resources of Tulare County and Their Utilization.
- 7—California Irrigation District Laws.
- 9—Water Resources of California. By P. Bailey.
- 11—Ground Water Resources of the Southern San Joaquin Valley. By S. T. Harding.
- 12—Summary Report on the Water Resources of California. By P. Bailey.
- 13—The Development of the Upper Sacramento River. By P. Bailey.
- 14—The Control of Floods by Reservoirs. By P. Bailey.
- 19—Santa Ana Investigation Flood Control and Conservation. (Maps) By W. S. Post.
- 20—Kennett Reservoir Development. By L. S. Ready.
- 21—Irrigation Districts in California. By F. Adams.

California State Division of Fish and Game:

- Vol. 15, No. 3, July 1929.

California State Legislature:

- Statutes and Amendments to the Codes, 1929.
- The School Code of the State of California, 1929.

California State Library:

News Notes of California Libraries:

- Vol. 24, No. 3, July 1929.

Florida State Geological Survey:

- Twentieth Annual Report, 1927-1928.

Georgia Geological Survey:

Bulletin:

- 44—Sedimentary Kaolins of the Coastal Plain of Georgia. By R. W. Smith.

Idaho Bureau of Mines and Geology:

- 32—Geology and Ore Deposits of the Lava Creek District, Idaho.

Indiana Conservation Department:

- The Geological History of the Vertebrates of Indiana. By R. L. Moodie.

Missouri Bureau of Geology and Mines:

- Vol. 22, 2d Series—Geology of Ste. Genevieve County, Missouri. By S. Weller and S. St. Clair, 1928.
- Biennial Report of the State Geologist.

## Wyoming Geological Survey:

Developed and Undeveloped Mineral Resources of Wyoming. By C. S. Dietz.

## Argentina Republica, Direccion General de Minas, Geologia e Hidrologia:

45—Informe Metalurgico Referente a Algunas Minas de Estano, Wolfram y Bismuto en la Sierra de Velasco. Por S. Wassman.

47—La "Salina del Bebedero" y sus relaciones con el sistema hidrografico "Andino" o del "Desaguadero." Por L. F. Deletang.

48—Memoria, 1924.

52—Las Perspectivas de Tratar Metalurgicamente el Mineral de Manganese. Por S. Wassman.

53—Las Minas de Hierro de Visvil. Informe Minero. Por N. A. Lannefors.

54—Informe sobre las Minas de Estano de Mazan y algunos otros Trabajos Mineros en la Sierra de Velasco. Por N. A. Lannefors.

55—El Hierro de Visvil. Informe Metalurgico. Por S. Wassman.

South Australia Director of Mines and Government Geologist:  
Annual Report for 1928.Western Australia Department of Mines:  
Report for the Year 1928.

## Bibliotheca Nacional de Rio de Janeiro:

## Documentos Historicos:

Vol. 8 da serie 6 dos Docs.

Vol. 9 da serie 7 dos Docs.

Vol. 10 da serie 8 dos Docs.

## Canada Department of Mines:

## Geological Survey:

2193—Britannia Beach Map—area, British Columbia. By H. T. James.

2202—Summary Report, 1928, Part A.

2206—Summary Report, 1928, Part B.

## Mines Branch:

695—Investigations in Ore Dressing and Metallurgy.

697—Investigations in Ceramics and Road Materials.

705—Comparative Tests of Various Fuels When Burned in a Domestic Hot Water Boiler. By E. S. Malloch and C. E. Baltzer.

—Investigations of Mineral Resources and the Mining Industry, 1927.

## Great Britain Geological Survey:

Vol. 31—Ball Clays, 1929. By A. Scott.

Sheet 137—Geology of Oswestry.

Summary of Progress for the Year 1928.

## Secretaria de Industria, Comercio y Trabajo, Mexico:

## Boletin Minero:

Tomo 27, Numero 5.

Tomo 27, Numero 6.

Tomo 28, Numero 1.

Tomo 28, Numero 2.

## Boletin del Petroleo:

Vol. 27, Nos. 4, 5, and 6.

## Departamento de Exploraciones y Estudios Geologicos Boletin:

Tomo 3.

Numero 48.

## Nova Scotia Department of Public Works and Mines:

Annual Report on the Mines, 1928, Part 2.

## Ontario Department of Mines:

Bulletin 69—Mineral Production of Ontario, for First Six Months of 1929.

Vol. 37, Part 6, 1928.



Quebec Province, Canada; Bureau of Mines:

Mining Operations in the Province of Quebec During the Year 1928.

Queensland, Australia; Secretary for Mines:

Annual Report for the Year 1928.

Bulletins du Comite Geologique, Leningrad, Russia;

Vol. 47, No. 7, 1928.

Vol. 47, No. 8, 1928.

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The Ken-tiube, Togai and other Iron-Ore Deposits in the East Karkaralinsk Region of the Kirghize Steppe. By M. Rusakov.

Die Dristallinen Schiefer des Irtyschgebirges. By N. Paduroff.

Transvaal Chamber of Mines:

Thirty-ninth Annual Report, 1928.

Deep Mine Ventilation.

Memoires du Comite Geologique, Turkestan:

Livraison 135—Materiaux pour servir a l'hydrogeologie du bassin houiller du Donetz.

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Alberta Scientific and Industrial Research Council:

Report No. 24.

American Association of Petroleum Geologists:

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Vol. 13, No. 10, October 1929.

American Geographical Society of New York:

Vol. 19, No. 4, October 1929.

American Philosophical Society:

Vol. 68, No. 2, 1929.

Archivos do Museu Nacional, Rio de Janeiro:

Vol. 29, 1927.

Australian Museum Records:

Vol. 17, No. 1—Contributions on the Permo-Carboniferous Aviculopectinidae of New South Wales. By H. O. Fletcher.

Vol. 17, No. 2—A Revision of the Genus Astartila. By H. O. Fletcher.

Vol. 17, No. 3—Studies in Ichthyology. By G. P. Whitley.

British Mining and Metallurgy Institution Transactions:

Vol. 37, 1927-1928.

California Academy of Sciences:

Vol. 18, No. 13—The Escallonias in Golden Gate Park, San Francisco, California, with Descriptions of New Species. By A. Eastwood.

Vol. 18, No. 14—Studies in the Flora of Lower California and Adjacent Islands. By A. Eastwood.

Vol. 18, No. 15—Drepania, A Genus of Nudibranchiate Mollusks New to California. By F. M. MacFarland.

Vol. 18, No. 16—Some Upper Cretaceous Foraminifera from Near Coalinga, California. By J. A. Cushman and C. C. Church.

California University Publications:

Department of Geological Sciences:

Vol. 18, No. 12—A New Cycad from the Mariposa Slates. By G. R. Wieland.

Vol. 18, No. 13—The Fernando Group in the Las Posas-South Mountain District, Ventura County, California. By E. D. Pressler.

## Canadian Institute of Mining and Metallurgy :

## Bulletins :

- 208—August, 1929.
- 209—September, 1929.
- 210—October, 1929.

## Canada National Research Council :

- Vol. 1, No. 2, July 1929.
- Vol. 1, No. 3, September 1929.

## Cakpamehto :

- No. 2, 1929r.
- No. 3, 1929r.

## Economic Geology :

- Vol. 24, No. 5, August 1929.
- Vol. 24, No. 6, September-October 1929.

## Engineer's Society of Western Pennsylvania :

- Vol. 45, No. 6, July 1929.

## General Engineering Company :

- Metallurgical Bulletin.

## Gorny Institute, Leningrad, Russia :

- Gorny Journal, No. 1, 1929.

## Institute of Mining and Metallurgy :

- No. 298, July 1929.
- No. 299, August 1929.
- No. 300, September 1929.
- No. 301, October 1929.

## International Geological Congress :

- The Witwatersrand Gold Field.

## Journal of the Western Society of Engineers :

- Vol. 34, No. 6, June 1929.
- Vol. 34, No. 8, August 1929.
- Vol. 34, No. 9, September 1929.
- Vol. 34, No. 10, October 1929.

## Library of Congress :

## Monthly Check-List of State Publications :

- Vol. 19, 1928.
- Vol. 20, Nos. 3, 4, 5, and 6.

## Mineralogical Society of America :

## American Mineralogist :

- Vol. 14, No. 8, August 1929.
- Vol. 14, No. 9, September 1929.
- Vol. 14, No. 10, October 1929.

## Mining and Metallurgical Society of America :

## Bulletin :

- 205—September, 1929.

## New York Academy of Sciences :

- Vol. 31—Studies in Chelonian Osteology. By H. Ruckes.

Part 1—Truss and Arch Analogies in Chelonian Pelves.

Part 2—The Morphological Relationships between the Girdles, Ribs and Carapace.

- Vol. 31—Chromosome Irregularities in Relation to Sterility in *Hemerocallis Fulva* Clon Europa. By A. B. Stout and T. Susa.

- Vol. 31—The Scenery of Mt. Desert Island; Its Origin and Development. By E. J. Raisz.

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No. 282—The Sand and Gravel Resources of New York State. By C. M. Nevin.

## Northwest Science:

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## Philippine Journal of Science:

Vol. 39, Nos. 1-4, May-August, 1929.

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## Philippine Bureau of Science:

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Tomo 5.

Tomo 20.

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## Rijks Geologisch-Mineralogisch Museum, Leiden, Holland:

Leidsche Geologische Mededeelingen:

On the Formation of Caldera's. By B. G. Escher.

## Rosenwald Industrial Museum:

Revealing the Technical Ascent of Man in the Rosenwald Industrial Museum.  
By W. Kaempffert.

## Ryojun College of Engineering Memoirs:

Vol. 1, Nos. 4-C and 4-D.

Vol. 2, No. 2.

## San Diego Society of Natural History Transactions:

Vol. 5, No. 16—Notes on the Marine Pleistocene Deposits of San Diego County, California. By F. Stephens.

Vol. 5, No. 17—A New Miocene Echinoid from California. By H. L. Clark.

Vol. 5, No. 18—Loliolopsis Chiroctes, A New Genus and Species of Squid from the Gulf of California. By S. S. Berry.

## Tohoku Imperial University, Sendai, Japan:

Vol. 11, No. 3—Science Reports, Second Series (Geology).

## Washington State College:

Vol. 11, No. 11—Importance of Preliminary Ore Analyses by Means of the Stereoscopic Binocular Microscope. By A. E. Drucker.

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Geophysical Prospecting. By A. I. M. E., 1929.

Modern Blasting in Quarries and Open Pits. By J. Barab.

The Mineral Industry During 1928. By G. A. Roush.

Microscopic Examination of the Ore Minerals. By W. M. Davy and C. M. Farnham.

Petrographic Methods. By E. Weinschenk and R. W. Clark.

Manual of Petrographic Methods. By A. Johansen.

Earthquakes and Building Construction. By Clay Products Institute of California.

Frost Heaving. By Stephen Taber.

## ohn Hays Hammond Public Mining Library.

Economic Geography. By Whitbeck and Finch.

The Theory and Application of Colloidal Behavior. By Bogue.

The Hydrous Oxides—Weiser.

Thermodynamics and The Free Energy of Chemical Substances. By Lewis and Randall.



- The Technical Examination of Crude Petroleum, Petroleum Products and Natural Gas. Hamor and Padgett.
- Handbook of Chemical Engineering. By Liddell.
- American Fuels. By Bacon and Hamor.
- The Preservation of Structural Timber. By Weiss.
- Laboratory Glass Blowing. By Frary, Taylor and Edwards.
- Chemical Warfare. By Fries and West.
- Radio Elements as Indicators and Other Selected Topics in Inorganic Chemistry. By Paneth.
- A History of Chemistry. By Moore.
- Reinforced Concrete and Masonry Structures. By Hool and Kinne.
- The Design of Mine Structures. By Ketchum.
- Design of Masonry Structures and Foundations. By Williams.
- Construction of Masonry Dams. By Smith.
- Concrete Engineers' Handbook. By Hool and Johnson.
- Concrete Practice. By Hool and Pulver.
- Hydraulics. By Schoder and Dawson.
- Hydraulics. By Daugherty.
- Water Power Engineering. By Mead.
- Hydrology. By Mead.
- Hydroelectric Power. Vol. I. By Lyndon.
- Hydroelectric Power. Vol. II. By Lyndon.
- Regulation of Rivers. By Van Ornum.
- Irrigation Practice and Engineering. Vol. I. By Etcheverry.
- Irrigation Practice and Engineering. Vol. II. By Etcheverry.
- Irrigation Practice and Engineering. Vol. III. By Etcheverry.
- Tunneling. By Lauchli.
- Practical Shaft-Sinking. By Donaldson.
- Estimating Building Costs. By Barnes.
- Contracts, Specifications and Engineering Relations. By Mead.
- English and Engineering. By Aydelotte.
- Topographical Drawing. By Stuart.
- Standard Handbook for Electrical Engineers.
- Practical Electricity. By Croft.
- Electrical Meters. By Jansky.
- Lighting Circuits and Switches. By Croft.
- Electrical Heating. By Wilcox.
- Electrical Power Transmission—Principles of Design and Performance. By Loew.
- Forest Resources of the World. By Zon and Sparhawk.
- Mechanical Engineers' Handbook. By Marks.
- Machinery Foundations and Erection. By Croft.
- Internal Combustion Engines. By Streeter.
- Compressed Air Practice. By Richards.
- Principles of Mechanical Refrigeration. By Macintire.
- Heating and Ventilating. By Allen and Walker.
- Handbook for Heating and Ventilating Engineers. By Hoffman.
- Strength of Materials. By Boyd.
- Properties and Uses of Wood. Koehler.
- Textbook of the Materials of Engineering. By Moore.
- The Working of Unstratified Mineral Deposits. By Young.
- Ventilation of Mines. By Weeks.
- Elements of Mining. By Young.
- The Cost of Mining. By Finlay.
- Steam Shovel Mining. By Marsh.
- Mine Bookkeeping. By McGarraugh.
- Mine Surveying. By Durham.
- International Mining Law. By Van Wagenen.
- Mining Without Timber. By Brinsmade.
- Field Geology. By Lahee.
- General Economic Geology. By Emmons.
- The Principles of Economic Geology. By Emmons.
- Interpretation of Topographic and Geologic Maps. By Dake and Brown.
- Geology of the Nonmetallic Mineral Deposits Other Than Silicates. By Grabau.
- Mineral Deposits. By Lindgren.
- Iron Ores. By Eckel.

Igneous Rocks and Their Origin. By Daly.  
 Practical Field Geology. By Farrell.  
 Introduction to the Study of Minerals and Rocks. By Rogers.  
 The Metallurgists' and Chemists' Handbook. By Liddell.  
 Engineering Metallurgy. By Stoughton and Butts.  
 General Metallurgy. By H. O. Hoffman.  
 The Science of Metals. By Jeffries and Archer.  
 Metallography. Part I. By Hoyt.  
 Metallography. Part II. By Hoyt.  
 The Flotation Process. By Megraw.  
 The Electric Furnace. By Stansfield.  
 Ore Dressing. Vols. III and IV. By Richards.  
 Ore Dressing: Principles and Practice. By Simons.  
 Tube Milling. By Del Mar.  
 Metallurgy of Copper. By Hofman-Hayward.  
 Metallurgy of Zinc and Cadmium. By Hofman.  
 Metallurgy of Lead. By Hofman.  
 Copper Refining. By Addicks.  
 Metallurgy of Tin. By Louis.  
 Metallurgy of Iron and Steel. By Stoughton.  
 Arc Welding Handbook. By Holslag.  
 Gas Torch and Thermit Welding. By Viall.  
 Petroleum and Its Products. By Gruse.  
 A Textbook of Petroleum Production Engineering. By Uren.  
 Oil Land Development and Valuation. By McLaughlin.  
 Elements of Optics. By Valasek.  
 The Physics of Crystals. By Joffe.  
 Wood and Cork—Pyrometry.  
 Inventions and Patents—Their Development and Promotion. By Wright.

#### aps.

U. S. Geological Survey Topographic Maps:

California:

Allensworth Quadrangle, Tulare County.  
 Alpaugh Quadrangle, Tulare County.  
 Ducor Quadrangle, Tulare County.  
 Pixley Quadrangle, Tulare County.

Arizona:

Wellton Quadrangle, Yuma County.  
 Fortuna Quadrangle, Yuma County.

Colorado:

Roan Creek Quadrangle.

Iowa:

Albia Quadrangle.

Missouri:

Des Arc Quadrangle.

North Dakota:

Sawyer Quadrangle.

Oregon:

Bend Quadrangle.

Pennsylvania:

Pennsylvania Coal Fields Map.

State Geological Maps:

Arkansas.  
 Alabama.  
 Florida.  
 Oklahoma.

Turkestan Geological Committee:

Geological Map of Central Asia (East Forghana).

**Current Magazines on File.**

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Architect and Engineer, San Francisco.  
Asbestos, Philadelphia, Pa.  
Asbestology, Canadian Asbestos Co., Montreal.  
American Trust Review of the Pacific, San Francisco.  
Bessemer Monthly, Grove City, Pa.  
Brick and Clay Record, Chicago.  
Caterpillar, San Leandro, Cal.  
Chemical Engineering and Mining Review, Melbourne, Australia.  
Commerce Reports, Washington, D. C.  
Colorado School of Mines, Golden, Colo.  
Engineering Graphic, Chicago.  
Engineering and Mining Journal, New York City.  
Explosive Service Bulletins, Wilmington, Del.  
Fusion Facts, Whittier, Cal.  
Graphite, Jersey City.  
Grizzly Bear, Los Angeles.  
Hercules Mixer, Wilmington, Del.  
Ingenieria, Mexico, D. F.  
Lubrication, The Texas Co., New York City.  
Mining Congress Journal, Washington, D. C.  
Mining and Industrial Record, Vancouver, B. C.  
Mining Journal, Phoenix, Arizona.  
Mining and Metallurgy, New York City.  
Mining Review, Salt Lake City.  
Mining Truth, Spokane, Wash.  
National Sand and Gravel, Washington, D. C.  
Nation's Business, Washington, D. C.  
Oil Bulletin, Los Angeles.  
Oil Field Engineering, Philadelphia, Pa.  
Oil and Gas Journal, Tulsa, Oklahoma.  
Oil, Paint and Drug Reporter, New York City.  
Oil Trade, New York City.  
Oil Weekly, Houston, Texas.  
Pit and Quarry, Chicago.  
Pacific Purchaser, San Francisco.  
Petroleum Times, London, E. C. 2.  
Petroleum Age, Chicago.  
Petroleum World and Oil Age, Los Angeles.  
Queensland Government Mining Journal, Brisbane, Australia.  
Record, Associated Oil Co., San Francisco.  
Rocks and Minerals, Peekskill, N. Y.  
Rock Products, Chicago.  
Scientific American, New York City.  
Southwest Builder and Contractor, Los Angeles.  
Standard Oil Bulletin, San Francisco.  
Stone, New York City.  
Through the Ages, Baltimore.

**Newspapers.**

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.  
Barstow Printer, Barstow, California.  
Beaumont Gazette, Beaumont, California.  
Bridgeport Chronicle-Union, Bridgeport, California.  
California Oil World, Los Angeles, California.  
Colusa Daily Sun, Colusa, California.  
Daily Commercial News, San Francisco, California.  
Daily Midway Driller, Taft, California.  
Del Norte Triplicate, Crescent City, California.



Denver Mining Record, Denver, Colorado.  
Exeter Sun, Exeter, California.  
Goldfield News, Goldfield, Nevada.  
Inyo Independent, Independence, California.  
Inyo Register, Bishop, California.  
Ione Valley Echo, Ione, California.  
Mercury Register, Oroville, California.  
Mojave Miner, Kingman, Arizona.  
Mountain Messenger, Downieville, California.  
Nevada City Nugget, Nevada City, California.  
Nevada Mining Press, Reno, Nevada.  
Oil Refinery News, Bayonne, New Jersey.  
Petroleum Press, Taft, California.  
Placer Herald, Auburn, California.  
Plumas Independent, Quincy, California.  
San Diego News, San Diego, California.  
Shasta Courier, Redding, California.  
Siskiyou News, Yreka, California.  
Sotoyome Scimitar, Healdsburg, California.  
Stockton Record, Stockton, California.  
Tuolumne Prospector, Tuolumne, California.  
Waterford News, Waterford, California.  
Weekly Trinity Journal, Weaverville, California.  
Western Sentinel, Etna Mills, California.



## PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *MINING IN CALIFORNIA* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of *MINING IN CALIFORNIA*, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list for *MINING IN CALIFORNIA*.

## EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

**Technical men**, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

## PUBLICATIONS OF THE DIVISION OF MINES

During the past forty-eight years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early reports and bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

## REPORTS

Asterisks (\*\*) indicate the publication is out of print.

	Price
*First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks -----	-----
*Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks -----	-----
*Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks -----	-----
*Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks -----	-----
*Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks -----	-----
*Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks -----	-----



## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

	Price
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.-----	-----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.-----	-----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.-----	-----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.-----	-----
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.-----	-----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.-----	\$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford-----	-----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper-----	-----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper-----	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper-----	-----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper-----	-----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper-----	-----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper-----	-----
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper-----	.65
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper-----	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper-----	-----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75

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	Price
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	\$0.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50
eventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth-----	1.75
ighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
*January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
apters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
apters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy-----	.25
apters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties-----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
apters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties-----	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties-----	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties--	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County-----	.25
apters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island-----	.25
April, 1927, Mines and Mineral Resources of Amador and Solano Counties--	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25
October, 1927, Mines and Mineral Resources of Mono County-----	.25
apters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1928, Mines and Mineral Resources of Tuolumne County-----	.25
April, 1928, Mines and Mineral Resources of Mariposa County-----	.25
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties--	.25
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties-----	.25
apters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines-----	.25
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties-----	.25
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties-----	.25
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties-----	.25
apters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)-----	Free

## REPORTS—Continued

Asterisks (\*\*) indicate the publication is out of print.

Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	Price
**April, **May, June, **July, **August, **September, **October, November, **December, 1919-----	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920-----	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
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## DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the state may be sent to the Division of Mines and Mining for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determination will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.



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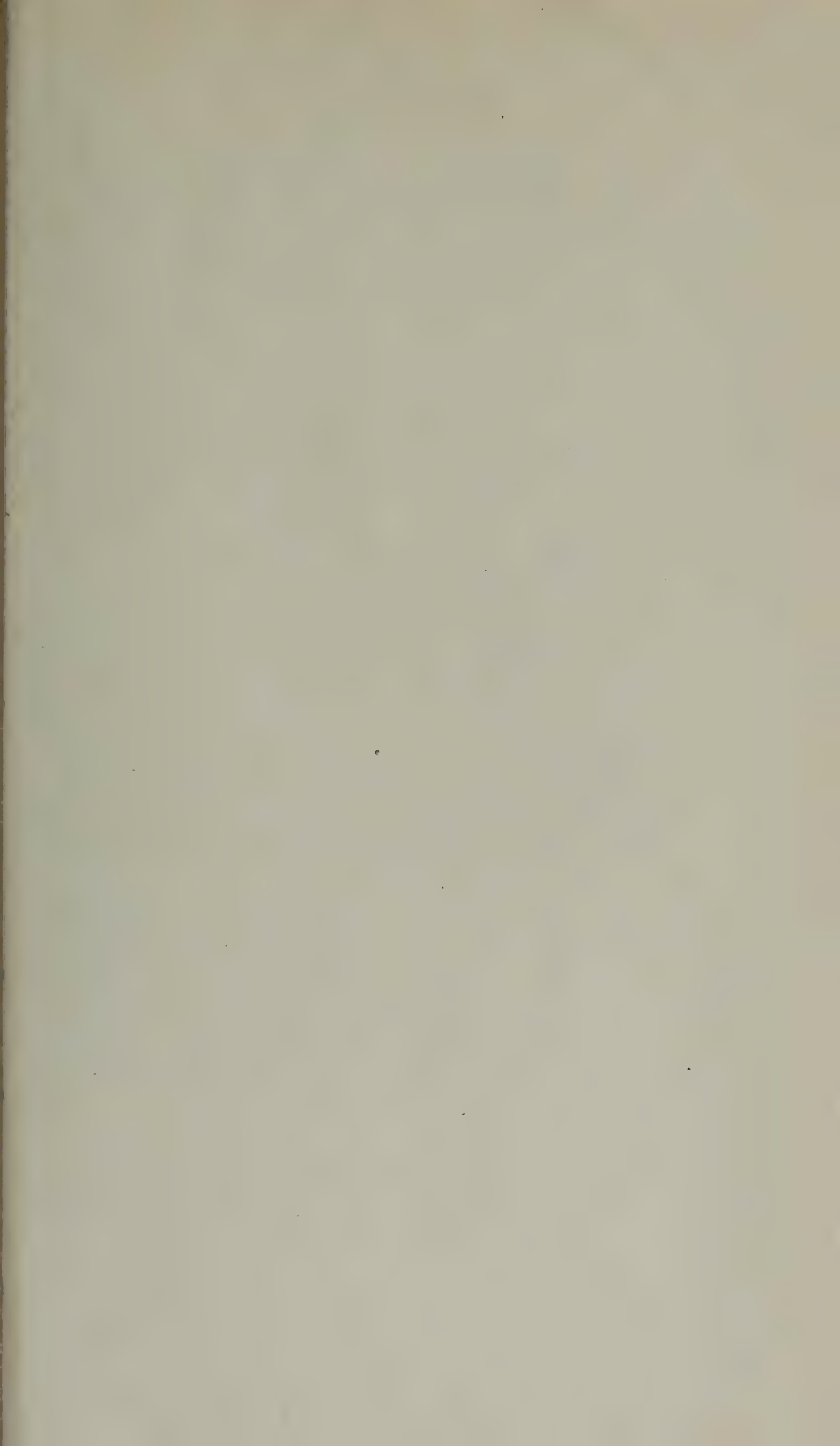


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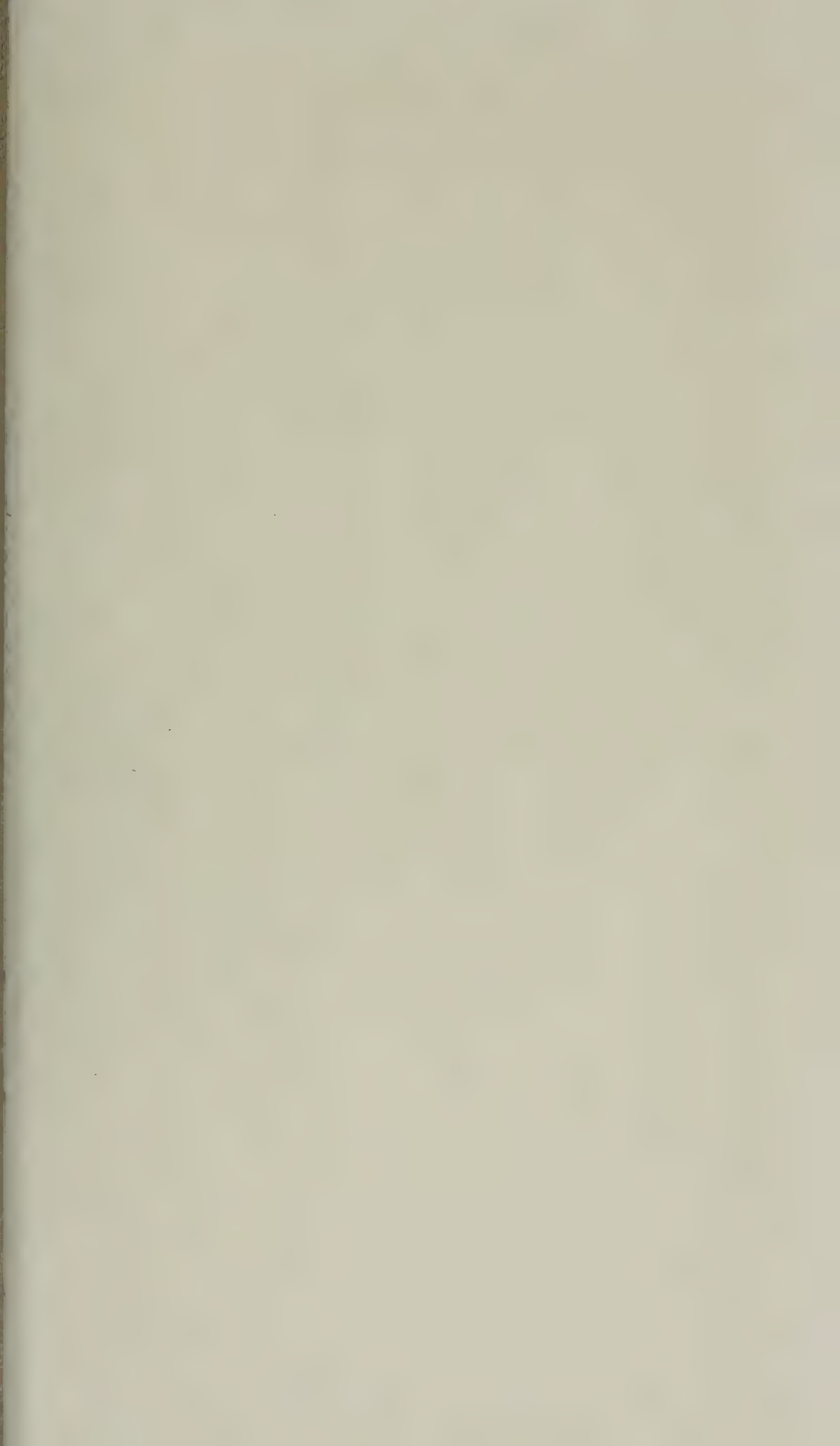
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Office hours: 9 a.m. to 5 p.m. daily  
Saturday, 9 a.m. to 12 m.

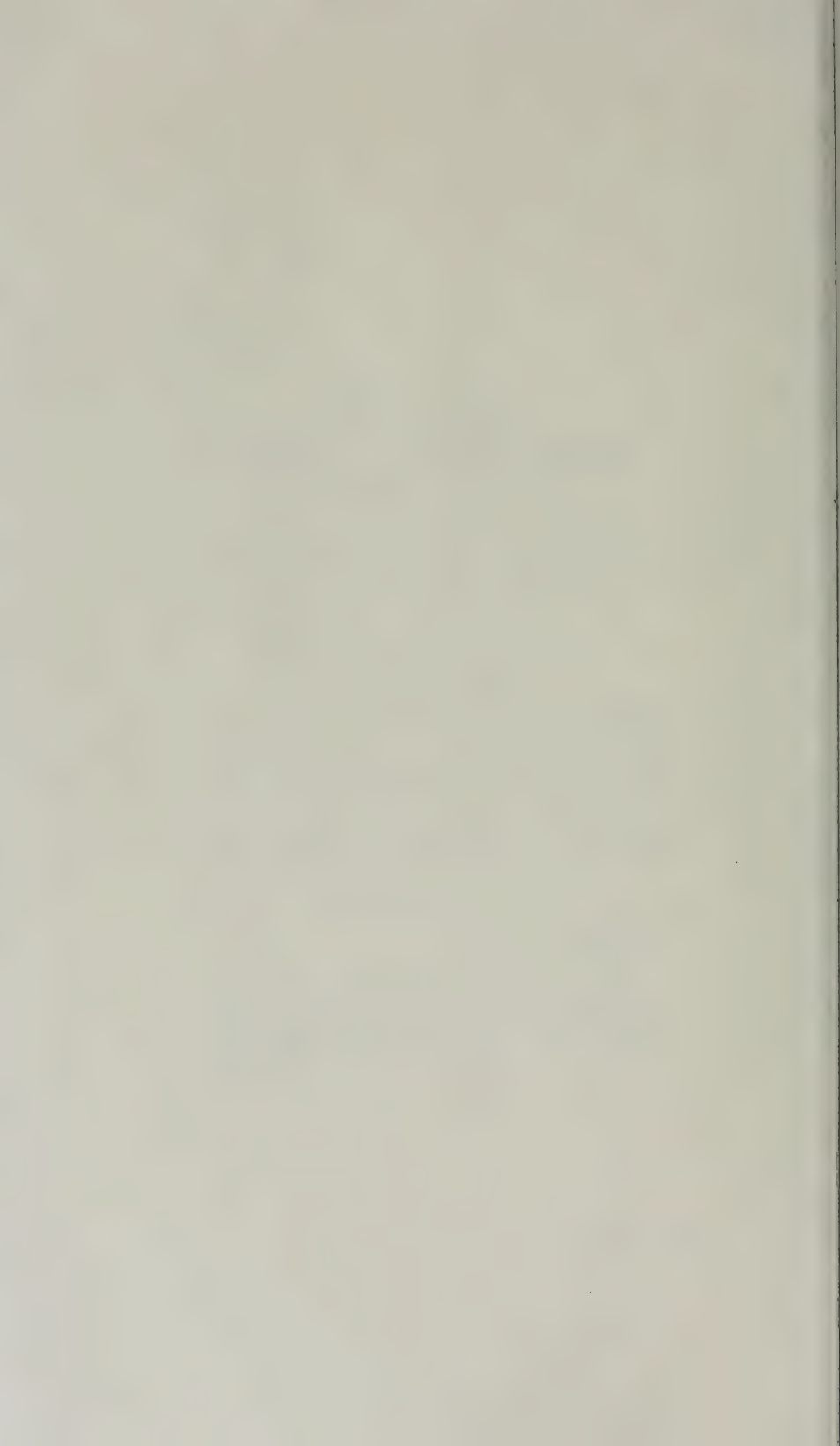
Walter W. Bradley,  
State Mineralogist.

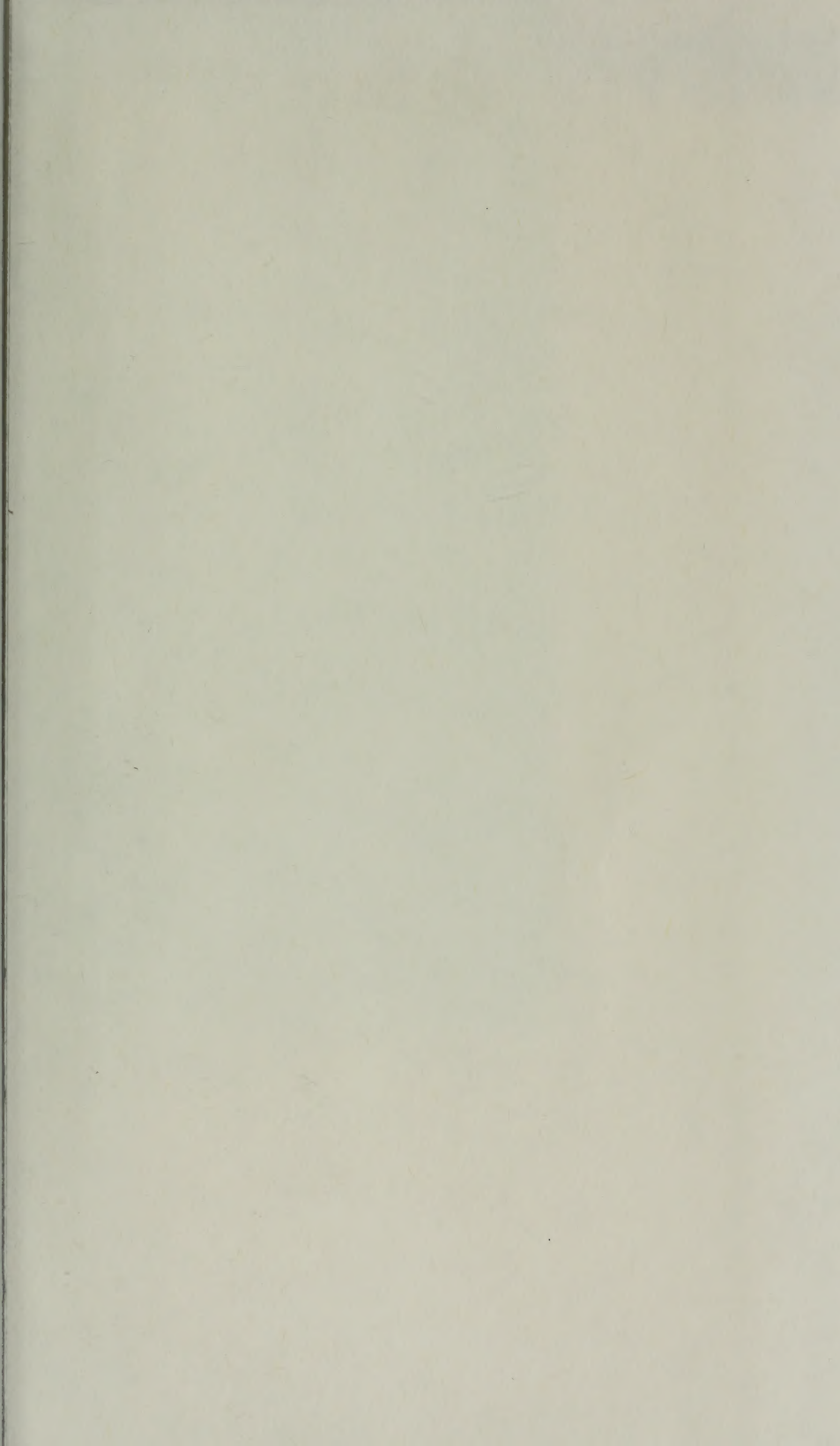
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